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PLANT CULTIVATION IN THE USSR

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The present work is compiled and published under the directive of the People's Commissar of Agriculture USSR, Comrade Ya. A. Yakovleva.

The workers of the Institute of Plant Cultivation hope that, fulfilling the commission of the People's Commissar, the Institute may with this fulfill also their obligation to create a scientific base for the socialist reconstruction of agriculture of our Soviet land.

FOREWORD TO VOLUME I

The appearance of the book Plant Cultivation in the USSR is an important event in the field of scientific agricultural literature. It is a book summing up the work of a group of scientists -- agronomists, "Selectioners," botanists, climatologists, and soil scientists -- a book supplying the total of our knowledge of cultivated flora of the Soviet Union for a definite period, giving a rough outline of the rational distribution of crops and of kinds of crops in the vast Soviet land.

Notwithstanding its numerous defects, this book is especially needed by the Soviet reader, whose questions and needs have grown quantitatively as well as qualitatively. The Soviet reader welcomes with great interest each new book dealing with questions of socialist agriculture, and the efficiency reported therein is being further increased by turning out a huge number of agronomists, directors of sovkhozes and MTS's, chairmen of kolkhozes and kolkhoz brigade leaders.

The book Plant Production in the USSR, summarizing the experience through many years of scientific research work in the great network of experimental stations, institutes, laboratories, etc., is un-

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gently necessary for the operational and planning workers of socialist agriculture.

Rational agriculture is incompatible with the private ownership of land. Capitalism condemns the multi-million mass of agricultural workers to conducting small-scale, scattered, backward, unprofitable, barbarian farming.

The application of machinery to agriculture is also known under capitalism, of course, but the best machines can be used only by large capitalistic establishments. The use of machinery -- the most complicated, expensive machinery -- is made impossible for the masses of small and middle-class peasant economy.

The Party and government of the USSR, in bringing about the socialist reconstruction of agriculture, have set as their task for the Second Five-Year Plan a radical technical revolution leading to the mechanization of all basic processes of agricultural production.

We have already become the greatest agricultural country in the world. On the basis of complete collectivization and large-scale construction of MTS's and sovkhozes, the sown areas in our country increased at the end of the First Five-Year Plan to 30 million hectares as against the prewar level -- the task having been set by the Party to strengthen our postwar position. We have called a halt to further expansion of areas given to technical crops, extending the sowing of grains and concentrating major attention on the raising of the yield of kolkhoz and sovkhoz fields as the central task of the Second Five-Year Plan.

Such improvements, such a revolution in the agriculture of the Soviet Union is in striking contrast with what the entire economy of the capitalist countries, particularly in agriculture, is undergoing. For a number of years the capitalist world has not emerged from a period of not only industrial but agrarian crisis.

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"In the course of the development of the economic crisis, the industrial crises of the chief capitalist lands not only occurred simultaneously but were interwoven with the agricultural crises in agrarian countries, aggravating the difficulties and predetermining the inevitability of a general fall of agricultural activity. It is not necessary to say that the industrial crisis will aggravate the agricultural, the agricultural tighten the industrial; that it cannot avoid leading to a deepening of the economic crisis as a whole." (J. Stalin, Political Report to the 16th Party Congress.)

A special means of the bourgeois government for emerging from the agrarian crisis is seen in the limiting of production and in the reduction of the sowing area, as a result of which this problem becomes not only national but international in scope. At the London wheat conference in June 1933, the United States proposed a reduction in wheat production and was supported by the majority of capitalist countries. A number of countries -- Germany, France, Italy -- started on the way to a virtually complete prohibition on imports of wheat, in spite of the fact that domestic production does not cover the needs of the population for bread.

While the Soviet Union carries on a battle on an expanding front to raise the yield, there they have a battle and bonuses for reducing the output of crops.

For us the good condition of the bread crops and favorable weather ^(are) important; on all the exchanges of the capitalist countries these same factors are considered very "inauspicious."

In the Soviet Union: the growing equipping of agriculture with the newest machinery and techniques, on the basis of developing and strengthening the sovkhozes and kolkhozes, the abolition of small and scattered holdings, the establishment of crop rotation for the large

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kolkhozes...in the capitalist world: bankruptcy of the mass of farms, sold under the hammer to the government and banks for non-payment of taxes and interest on the mortgage -- the degradation of small peasant farming.

At the All-Union Congress of Kolkhoz Shock-Workers, Comrade Stalin proposed a slogan which fully expresses the stage of development we have reached and the immediate objectives which we may postulate on a basis of what we have already reached: to make all the kolkhoz members prosperous in the very next years.

"We have achieved, thanks to the kolkhozes, the raising of poor people to people who are moderately well-to-do. This is very good but not good enough. We must now make a further step and help all kolkhoz members, both the poor and the better off, to raise themselves to a level of prosperity. This we may achieve and this we must achieve, at all costs." (J. Stalin.)

Might not some capitalist country, - in which thrives unemployment, enveloping today up to 50 million people, among whom many are skilled workers, as well as engineers, technicians, physicians, professors, artists, doomed to hunger, begging, wandering through the streets in search of any kind of job - set itself the task of transforming the many millions of the peasant masses into prosperous people? Of course not. Instead - crisis, sharpening the contradictions of the capitalist economy, is drawing the broad masses into deeper and deeper poverty.

A completely new, unprecedented production of a socialist type has been created by us. It represents in its productive power and in its inner structure a considerably stronger and more complicated organization than the previously prevailing type of economy. And this signifies, as Comrade Stalin says, that "the kolkhoz structure does

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not decrease but increases the problems and responsibilities of the Party and government as regards the development of agriculture." Therefore the planning of agriculture, the disposition of crops and grading of crops, the establishment of crop rotation, becomes a problem on the solution of which the entire Party will work. In our present position, each decision, when there are unconditionally all possibilities of realizing it, becomes especially critical and especially important; every piece of reference material concerning this matter which is given to specialists ought to be verified ten times over, above all from a point of view of conformity with the interests of the State.

The planning of agricultural production ought to come from a State task which is completely and clearly set forth. This planning ought, concurrently, to take into full consideration the climatic and soil conditions of the regions, those huge possibilities of development of an economy characterized by a high degree commodity exchangeability, which make for a transition to a kolkhoz economy.

This present work on the disposition of agriculture, carried out in accordance with the task set by the People's Commissariat for Agriculture together with scientific research institutes, is not completed, but at present there is already gathered enough material characterizing the individual districts and regions of the USSR as regards climate^(S), soil, individual kinds of seed, breeds of cattle, possibilities for an increase of grain resources in regions of technical crops, possibilities for the introduction of new crops, etc.

The basic objective of Plant Cultivation in the USSR is to present scientifically verified material pertaining to the distribution of crops and grading of crops in the Soviet Union.

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Unfortunately, we do not have this in full in the present book. Many vital questions, linked with the problems of the radical reconstruction of our agriculture, are not duly reflected upon, and in a number of cases are elucidated incorrectly.

The greatest defect to which the reader's attention is invited is the circumstance that plant cultivation in the USSR and the prospects for its development are considered in this book almost exclusively from a point of view of natural-historic factors, without consideration of the economies of different districts and the Union as a whole. Moreover, in it there is no reflection of those huge possibilities of changing the composition of our body of crops and varieties of crops which are called for by the whole structure of the Soviet state.

For instance, in the article of G. T. Selyaninov, "Specialization of Agricultural Zones according to Climatic Conditions," in which are correctly described the climatic differences of the USSR, the zones are considered only from the point of view of climate, without calculation of soil and economic conditions, which, of course, cannot lead to exact conclusions.

The aspiration to carry out a redistribution of crops rising only from "climatic considerations" is a very crude methodological error, leading to a situation where all the very rich material on the characteristics of the regions by Selyaninov may serve as raw material for another author, who will take into consideration a variety of conditions, but with those figures and climatic indices. At the very beginning of the article, G. T. Selyaninov is compelled to assume the old postulate, that one can consider the limitations of crops apart from soil conditions, apart from topography, apart from the social structure of the economy. On such a formulation of the question spoke the old school of isolated,

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decracinated, narrow-minded, abstract work, which leads to a hypertrophy of narrow climatic conceptions, while a work considering the complex -- simultaneously considering the influence of different factors -- may give us those positive results which we could have anticipated.

Another such article, reflecting an academic isolation from the practical questions of socialist agriculture is that of L. I. Prasolov "Land Area Available for Plant Cultivation in the USSR, with relation to the Geography of Soils."

The author deals with soil in almost as isolated a manner as G. T. Selyaninov deals with climate. Putting the question to what "limits" may our seeded area expand, he decides that it may be expanded 40 percent. The soils of individual district are dealt with altogether apart from climatic and other considerations. And yet it is widely known that one and the same soil in the north of the USSR and in the south -- i.e., in different climatic conditions -- may wholly adapt itself to different rates of growth and application of completely different methods. May one generally bring forth the question about the quantitative "limits" of the expansion of arable land? The very putting of the question cannot be recognized to be a rational consideration of goals, inasmuch as everything depends upon the social-economic structure of a country -- upon the conditions of science and technology in every given period, upon those capital investments which are possible in a given time.

We need an agronomic map of the agricultural regions of the USSR on the basis of which we can move our agriculture to a higher level, but not general judgment about the geography of soils. Here also is evident that the influence of the old school of soil scientists, divorced from questions of socialist agricultural production, has not been overcome.

The soils themselves, as appears from the work of the author,

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are not considered dialectically, not in their possible changes under the influence of crops. We need not so much a study of the "natural fertility" of soils as an elaboration of methods for the raising of fertility of each soil type.

Taking the path shown by such one-sided research the works of Selyanin and Prasolov and carrying on only a comparison of the character of soils or climates, we would need to come to completely absurd conclusions and in every case would not be able to set such tasks for ourselves as the expansion of the sowing of wheat in consumption regions, as the creation of new sugar-beet regions, etc.

A lack of appreciation of the potential of the southern zone was shown also in the article of A. N. Kostyakov "Major Aims and Reclamation Problems related to Objectives of Plant Cultivation in the USSR."

Thus, both the articles of L. I. Prasolov and A. N. Kostyakov may also be used only as material for very elementary characteristics of soil and directing of large-scale amelioration of them in the Soviet Union.

The division into zones of agriculture, the disposition of crops and grading of crops may insure the quickest attainment of those basic objectives which the Party and government of the USSR have set up, namely the conclusive resolution of the wheat problem, and, first in order, the raising of the yield and expansion of the sowing of wheat and the establishment of forage bases for the development of Socialist stock-raising.

The book now being released may be considered as the first approach, as an elementary outline for the elaboration of a plan of development for agriculture pointing out a higher direction.

Doubtless the book is very tardy. It has been in printing for two years, which has meant that achievements in practice in agriculture

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have already significantly outstripped a number of outlines which were made in this book. In a number of districts of the Soviet Union at present crop rotation, with the exact disposition of a number of crops, has been introduced and carried out for each rural soviet, for each kolkhoz. In the majority of districts, crop rotation is not in sharp contradiction with the outlines of Plant Cultivation in the USSR, the materials of which on the establishment of crop rotation were used by producers, particularly as regards the zoning of different kinds of crops.

Very much of what was only recommended in this book, in the matter of kinds of crops, has in recent years already been put into practice on a large scale. The best of the specially-recommended kinds already occupy millions of hectares (Ukrainka, Lyutestsens 062, Cesium 0111, etc.)

The significance of grading in raising the yield and in high-land agricultural engineering, for which we must struggle, is very great, as is evident from the figures of Professor Remer cited below. The harvest under study of crop grading for 4 years in Halle, Germany, gave this fluctuation of harvests (centners per hectare) (Remer and Scheffer, "Ackerbaulehre" p. 333)

<u>Name of Crop</u>	<u>Lowest Grade</u>	<u>Highest Grade</u>	<u>Difference in Favor of Highest Grade</u>
Winter wheat	29.95	47.89	11.64
Winter barley	37.63	59.26	17.56
Winter rye	35.12	53.44	12.73
Oats	22.22	41.80	17.60
Spring wheat	25.78	39.18	6.43
Spring barley	35.15	44.82	4.29

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On the basis of many years experience at the State Grading Bureau, we may also affirm as regards a number of crops that the best selected varieties under conditions of graded lots of land -- and the majority of the graded lots, as a rule, are located on the sovkhozes -- exceeded the local seeded material in yield: winter wheat 20-30 percent, winter wheat -- Triticum vulgare -- 10-40 percent, winter durum wheat 10-50 percent, barley, on the average, 36 percent, and oats 23 percent.

The Soviet Government, in that most difficult year for us, 1921, the year of drought in the southeast, had already brought up the question of organizing selection and seed-raising in our country.

One may assert with confidence that selection and seed-raising practically did not exist before the revolution, and that it is wholly a creation of the Soviet Government, though Professor V. Ye. Pisarev was not unaware of it, and point out that under prerevolutionary conditions the establishment and organization of seed-raising had been "outlined" and it was as if only "the world war held up the construction that was getting underway."

Planned development in matters of scientific research is for us completely and fully associated with the Soviet Government. We may say that all branches of agricultural production are now backed by a huge network of establishments for scientific research with stations for the various zones, serving different physical-geographic regions. We may already boast the presence of millions of poods of selected seed, making possible realization of Party and government objectives of establishing a 100-million reserve [sic] of choice seeds for the satisfaction of the demands of Soviet agriculture.

Scientific research institutions of the Academy of Agricultural Science imeni V. I. Lenin exist both within the Arctic Circle (the

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Khibini Branch of the Institute of Plant Cultivation and in the sub-tropics, Sukhumi, Batumi, Turkmenia). The presence of this huge net work in different climatic and soil conditions of the USSR makes possible maintaining and increasing world plant resources, all that huge biological supply which is available on the globe and has been gathered by Soviet expeditions.

The worst evil in our agriculture was the presence of a multitude of "varieties" of unknown origin. Research conducted by the People's Commissariat of Agriculture in 1930 revealed 54 varieties of winter wheat, 45 of ~~summer~~ ^{spring}, not less than 25 varieties of oats, and 33 of barley. Among them was much worthless stuff of low yield. It was impossible to demand of the warehouses that they keep and take stock of the best from each conglomeration of varieties. It is completely clear that the standardization and unification of the varieties of crops is our first task. That classification and reduction of the number of types is called for is evident from the following figures:

<u>Name of Crop</u>	<u>Epecially</u>			
	<u>Recommended</u>	<u>Recommended</u>	<u>Admissible</u>	<u>Total</u>
Spring wheat	7	4	10	21
Winter wheat	5	7	7	19
Oats	6	7	3	16
Barley	4	9	9	22
Corn	5	8	3	16

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A state network for experimenting in grades and varieties of crops, taking in always more and more new types having indices higher than the best of the old, will introduce corrections in establishing standards and classifying and unifying the various types.

At the same time though, it is certain that in the huge territory of our country the number of varieties cannot be too greatly reduced without damage to the yield.

Those varieties acceptable for propagation are put into three groups: "Especially Recommended", "Recommended", and "Admissible". The especially recommended types are those which under conditions of not less than 5 years of competitive experimentation in the State Grading Bureau prove not only the best in yield but stand up the best against blight and disease, against unfavorable climatic conditions, have a high quality of seed, and also fulfill the demands of a mechanized economy.

Soviet scientific-research work, as distinguished from bourgeois science, has from its inception wholly favorable conditions of work, for every conclusion and achievement immediately becomes the property of the working millions and receives the widest application in practice, whereas in the age of the bourgeoisie the most necessary discoveries and inventions find no application to the masses of the peasantry. For the many millions of peasants newest methods of rational agriculture, based on the best crop rotation, on the application of improved machinery and fertilization and use of the most valuable type of crop, are completely unavailable.

Only in our country do scientific achievements become the means for an unprecedented raising of the well-being of the broad masses, for the growth of production on a huge scale. The slogan "make all the kolkhozes prosperous" consistently carries out the general line of the Party, which draws on all the greatest achievements of science.

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In all the bourgeois press it is more and more urgently demanded that a "holiday" be declared for science and invention, due to the rise in the productivity of labor. Under the conditions of capitalism, every scientific achievement now does not enrich mankind, raising the productivity of labor, but is directed against it, leading to crisis and unemployment.

Nowhere as in our land is science based on such favorable conditions of work, representing not a few individual, solitary, widely-scattered, closed-off laboratories, but laboratories linked to a single system operating in a complex manner, supplementing one another.

We have geneticists, cytologists, "selectioners," botanists, physiologists, anatomists, biochemists working on the development of plants which are drought-proof or cold-resistant, or immune to various diseases. From the morphology, with the aid of chromosis, of one type of wheat or another to its actual behavior on the plot of a kolkhoz brigade may intervene a complex study of some type of wheat. Our vast land comprises a huge number of the most varied natural-historic combinations, differences of temperature and soil and precipitation, and thus demands an equal variety of plants acclimatized and redeveloped on a higher level of productivity. We need wheat which will grow on the irrigated land of Central Asia and wheat which will grow on ^{non-irrigated land.} ~~irrigated land~~; we need wheat for the valleys of the Caucasus and for heights a thousand meters above sea-level. We need wheat which will grow on the steppes of Kazakhstan and Crimea; wheat which grow under the conditions of the snowy harsh winters of the Soviet east and the snowless steppes of the lower Volga; wheat which yields a large harvest under the conditions of the Northern Caucasus and of the Far Eastern coast. Some one type, or even two or three, cannot satisfy all these varied needs, and the thought of scientific workers and the armies of "selectioners"

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must turn to the conquest of the vast spaces of our land so that we may discover new types and carefully propagate these types on tens of millions of hectares.

The work of selection was previously carried out on a small scale, at slave's tempo, without necessary scientific equipment, dooming the "selectioners" to the inevitable loss of many years. The newest work, based on a dialectical method, carried out on a huge scale under the varied conditions prevailing in the Soviet Union makes possible conserving time by using space. Under conditions of great heat, in hot-houses -- with which our scientific establishments are now provided -- hundreds of thousands of seeds may be obtained in one year from a single seed, with a six-hundred-fold reproductiveness obtained. In rooms of artificially-controlled temperature we do not have to wait for cold weather to subject the available and the newly-introduced types of plants to experimentation in cold-resistability in snowless cold weather, in different harsh temperature conditions, as well as under the influence of high temperatures and dry winds. All this was unavailable to earlier laboratories. Only under the Soviet Government have we created the possibility of large-scale work on hybridization of the most different crops, and, what is most important, thanks to expeditions to many countries of the globe, we have amassed the richest stock of diverse plants in the whole world. One may say without any exaggeration that the link between the Institution of Plant Cultivation and all the scientific establishments of the globe assures regular receipt and reproduction of the entire world's growing stock, which may and ought to be used by our "selectioners."

Is all done that might be done by our scientific establishments in these conditions favorable for scientific works? No, for far from all

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of our establishments have adopted those tempos of work which are called for by the rapid growth of our heavy socialist mechanized farms with their specialized demands. The work is often carried on as it was ten years ago, as if the results were not awaited impatiently by the many millions of kolkhoz workers.

Soviet scientific thought has freed itself but slowly from the old bourgeois traditions of abstractness in work, from the old non-dialectical methods of investigation, the incorrect methodology. Only gradually, with the influx of young Marxist cadres, has dialectics penetrated the field of scientific investigatory work. On a number of plots of land using selective methods of work, the fruitfulness of applying dialectical methods has already been verified -- and the mastery of the dialectical method by our cadres of "selectioners" promises us beyond doubt a great victory in the very near future in this field, in obtaining new varieties of plants.

Matters stand especially badly as regards the distributing of already revealed and tested varieties. One might point, first, to the fate of the Moscow 02411 wheat, the distributing of which was completely unsatisfactory; it is enough to remember the fate of Novinka, the fate of the rye-wheat hybrid obtained by Professor Meyster, to understand that those scientific research stages are especially neglected, insufficiently provided-for sectors of work, when the newly-discovered varieties ought to have been widely propagated. (The work of Professor Meyster with rye-wheat hybrids is of exceptional interest, and one ought to note here the case, very important theoretically, in which he obtained a 56-chromosome plant and a series of forms of hybrids of rye and wheat, from which were isolated a number of varieties of winter wheat distinguished by their high resistance to cold and drought and by a special vitreousness

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of the grain.) There have been cases in which the best varieties had to be removed from experimentation, for lack of even enough seeds for this end, when competitive experimentation in them was put aside for an indeterminate time. Such cases were linked with the sabotage led by Vol'f in the field of agriculture and is a continuation in conditions of scientific work and scientific work applied to production of that class struggle which the smashed but still not decisively beaten class enemy carries on, a sabotage which did not meet with the necessary current support on the part of all the masses of scientific workers.

But we also have models for really Bolshevnik work, as, for example: work in acclimatizing Egyptian cotton; work in developing a high-yielding type of sugar-beet, as a result of which in our land we completely substituted seeds of Soviet selection for imported seeds of a German firm on all the sowed fields of sugar-beet in the USSR; work in developing new frost-resistant types of potatoes for use above the Arctic Circle; work in developing very productive types of wheat, rye, oats, barley, and other crops.

To those deficiencies of the book we have mentioned, characterizing the first articles on climate and soil, deficiencies represented by a manifestation of mechanical and dialectical ideas about nature, not considering the huge social-economic changes which may take place, one ought to add that in the majority of the articles both agriculture and the plants themselves are considered unchanging factors, not passing through their stages of development and movements.

Agricultural engineering, which to a decisive degree influences plants and moreover influences different plants differently, is completely ignored, except in an application of one or another procedure of agricultural engineering. Only in a few of the articles (for example, that

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on summer wheat) is it mentioned that concurrently considering types of plants and agricultural engineering completely changes the picture of agricultural development.

Let us take up the matter of winter wheat for the Trans-Volga region. It is known that ^{the use of clean fallows} ~~the application of pure vapors~~ and other methods of accumulating and preserving moisture in the soil together with the application of methods of snow retention on a large scale increase the ability of winter wheat to endure winters which are harsh but with little snow. In a number of articles we have the consistent expression of the view that the whole matter depends upon the grades of wheat used and that it is not worth while to create new, sturdy types of wheat to introduce in the fields of the Soviet Union.

This position does not even have its source in the data cited in the book, and is in full contradiction with the directives of the Party and Government concerning the development of sowing of wheat in the region along the Volga.

The work of the agronomist Lysenko became generally known long ago, cleverly applying a method of vernalization to the shortening of the growing season of a number of plants and giving thereby a 15-20 percent increase in their yield. This method of vernalization so decisively shifted various phases of the plant development that it became possible to speak about transforming winter crops into summer, southern into northern, etc. A number of plants which in our weather conditions had never ripened, he succeeded in putting in such favorable conditions by the method of vernalization that they bore seeds (for example, English and Algerian wheat).

The failure to consider the meaning of the practical results of the vernalization method, in 1933 already applied to hundreds of thousands

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of hectares, is the worst omission of Plant Cultivation in the USSR, since precisely this method, already widely used in the south, very greatly changes the picture of possible distribution of crops, and may have a huge significance particularly in the solution of the problem, -- the most important problem of today -- of advancing winter as well as summer wheat in the north.

We have hundreds, even thousands, of cases of high yield of wheat with improved agricultural engineering and the use of fertilizer in consuming areas (Belorussia, the Western, Moscow, Ivanovo, Lenigrad oblasts, the Gorkiy and Northern krais), reaching 30 centners per hectare even without the application of vernalization which, giving an acceleration of plant growth of 10 or more days, could become under conditions of northern agriculture one of the most important factors.

By using vernalization on a large scale the solution of the problem of land utilization is simplified and accelerated in a number of zones -- in the cultivation of swamps, plains, unfavorable soil and climatic zones, etc. If in the swamps of Belorussia even without using the method of vernalization we obtained fully ripening forms of rice, if geraniums were obtained there which previously grew in the conditions of a subtropic zone, if we obtained cigar tobaccos with all their valuable qualities, then the application of vernalization on a large scale -- not only with wheat, cotton, and potatoes but with other grain and technical crops -- promises great success.

One ought to mention the achievement of Soviet science in study of the most varied new crops, which put into wide use can give huge additional sources of many millions of crops for feeding the population and of raw materials for processing. Plants rich in albumen, starch, fat, etc., were in a wide assortment of varieties introduced for the first

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time in the Soviet Union. Contemporary Soviet agriculture and the agriculture which the Soviet Government inherited from Czarism not only have nothing in common in the social-economic field, inasmuch as the kolkhozes, MTS's, and sovkhozes took the place of the old, small-scale, horseless farming, but also the assortment of crops has changed. Egyptian cotton, never before seen in our land has appeared and multiplied; a huge area is given over to the sowing of sugar beets, exceeding sowing on the pre-war level; new crops have appeared which already occupy hundreds and thousands of hectares, such as the soy-bean, chicory, Jerusalem artichoke, new oil-bearing, ether-bearing and rubber-bearing plants, the castor plant, the safflower, the sesame, the geranium, tea, aurantiaceae, etc. A number of completely new crops, still unknown even by name to the general Soviet public, are making headway.

The most serious defect of the book is the absence of a clear social-political and economic line concerning the problems facing the different zones of the country.

The book concerns plant cultivation in the narrowest sense of the word -- i.e., plant cultivation which is abstracted from contemporary economic conditions, plant cultivation really occupied only with plants as such, issuing from the statics of that environment in which these plants are found.

The growth of the population of the Soviet Union and the huge growth of its needs in connection with industrialization and the socialist reconstruction of agriculture demand the realization of those directives which were given by the 17th Party Congress and the subsequent plenum of the Central Committee and the Central Control Commission of the VKP (b) concerning the development of agriculture in the Second Five-Year Plan.

A completely clear line has been given by the Party and Government

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for the definitive solution of the grain problem, which is also the basic premise for the solution of problems of socialist stock-raising. And thus the problem of technical crops as raw material for light industry may also be solved.

However, the resolving of these fundamental problems brought up by the Party and Government, and especially of the most important of them, the wheat problem, is completely insufficiently dealt with in the basic articles of Plant Cultivation in the USSR. The author of the article on grain crops considers the problem of expanding new areas in an extraordinarily general and abstractly theoretical manner, not clearly putting the point that we must expand areas under winter and ^{spring}~~summer~~ wheat in the first place, giving instead, in a number of cases, ill-founded, incorrect reasons for curtailing wheat crops in individual districts.

Wheat sowing in our country covers 35 million hectares, of which winter wheat is only a third -- around 12 million hectares -- while two thirds of the wheat sowing is in summer wheat. Such a relation between ^{spring}~~summer~~ and winter wheat speaks for the insufficient economic grounding and unsatisfactoriness of this division, regarding the distribution between fall and spring of intensity of work. If one turns to the question of yield, there the picture of the unprofitableness of the relation between ^{spring}~~summer~~ and winter wheat becomes even clearer. The relation within the wheat field ought to change to the benefit of winter wheat, in view of its definitely large yield -- for, as a rule, in the majority of districts in which both winter and ^{spring}~~summer~~ wheat is sowed with the same agricultural techniques, winter wheat has proved always better yielding.

Inasmuch as the book contains pre-war statistics on all crops, we consider it appropriate here to call to mind the devastating evaluation which V. I. Lenin gave of Czarist statistics, which brought together

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under one heading of economy different sizes, different levels of techniques, different scales of capital, dumping in the same heap poor, middle-class, kulak, and landlord economies without differentiation. Therefore, the pre-war data on yields which are used for purposes of comparison in all the articles should be taken with a great deal of distrust and scepticism, especially as concerns the size of pre war seeding areas, given completely incorrectly.

Comparing the yield of winter and ^{spring}~~summer~~ wheat in individual districts of the USSR, we see that the harvest of one hectare of winter wheat exceeds the harvest of summer wheat by more than 100 percent. Thus, for example, if we take the right bank of the Dniepr, in the forest-and-steppe regions of the Ukraine -- according to data of the State Grading Bureau, on the Chertoriysk ^{test}~~graded~~ plot the winter wheat Ukrainka yielded 27.8 centners per hectare, while the summer wheat Lyutestsens 062 yielded only 12.7 centners per hectare, and thus the harvest of winter wheat exceeded that of summer by 15.2 centners, or 119 percent. We have no less interesting results in the forest-and-steppe area of the Central Black Earth Zone, where on the Voronezh ^{test}~~graded~~ plot the winter wheat Gostianum 237 yielded 32.2 centners per hectare, as against ^{Cesium}~~Tacsum~~ 0111, with 11.5 centners per hectare, and advantage of 20.8 centners per hectare, or 181 percent (1925-26), and also on the Shatilovskiy ^{test}~~graded~~ plot, where the winter ^{Eritrospermum}~~Erythrospermum~~ 09016 yielded 19.6 centners per acre as against the summer ^{Cesium}~~Tacsum~~ 0111 which yielded 4.7 centners per hectare, an advantage of 13.9 centers or 444 percent.

If we take the left bank of the forest-and-steppe area of the Ukraine, in a number of ^{test}~~graded~~ plots once again winter wheat yield exceeds summer 50-80 percent. Thus, on the Kharkov ^{test}~~graded~~ plot, for 5 years (1926-1930), ^{Eritrospermum}~~Erythrospermum~~ 0916 gave 22.2 centners per hectare as against Lyutestsens

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062 with 12.1 centners per hectare, an exceeding of 10.1 or 83 percent. There Ukrainka also gave for these years 21.6 centners per hectare as against Lyutestsens 062 with 12.2 centners per hectare, an advantage of 9.4 centners per hectare, or 77 percent. On the Sumi station Ukrainka yielded 23 centners per hectare for 6 years against the winter Lyutestsens 062 12.2 centners per hectare, an advantage of 8.9 centners per hectare or 69 percent.

Data from the sovkhoses and kolkhoses of the Ukraine, the Central Black-Earth Zone, and data from individual farms also confirms the decisive advantage of winter wheat. If we take the North Caucasus, according to data of the State Grading Bureau the yield of winter wheat exceeds ^{spring} summer in all zones -- in the zone of sufficient moisture, in the zone of variable moisture, and in the drought zone.

Thus, for example, the Kabardino ^{test} ~~garden~~ plot, located in the zone of sufficient moisture, for 1927-29 yielded 19.6 centners per hectare in winter wheat Kooperatorki as against the summer Lyutestsens 062 yield of 6.6 centners per hectare -- an advantage of 13 centners per hectare or 197 percent. Ukrainka for the same period yielded 15.8 centners per hectare as against the winter ^{Casium} ~~Reantam~~ 0111 6.2 centners per acre, advantage of 9.6 centners per hectare or 161 percent.

On the Prikumsk plot, located in the southeast drought zone, Gostianum 0237 gave for 4 years (1927-30) 16.6 centners per hectare against Lyutestsens 062 5.2 centners per hectare, an advantage of 11.4 centners per hectare or 219 percent.

The figures for harvests on the North Caucasian sovkhoses and kolkhoses for these same years show winter wheat to be superior but in considerably lesser degree. And so, although the superior yield of winter wheat over ^{spring} ~~summer~~ is an established fact, the matter of establishing the

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predominance of winter wheat must be handled with special care in the Ukraine and the North Caucasus -- two basic wheat-growing areas of our country -- and in "that part of the zone of unstable moisture where ~~spring~~ ^{spring} wheat is doing well, allowing a high harvest, a high quality for export."

If we take the southern steppe of the Ukraine and the Crimea, data of the State Grading Bureau for the last 5 years shows the same superiority of the winter wheat harvest over the ~~summer~~ ^{spring} (on the order of 30-60 or more percent). Considering that the grain of the winter wheat of the southern steppes is the best quality of all the winter wheat of the Soviet Union, except that of the North Caucasus, we must also come to the conclusion here that developing the sowing of winter wheat is necessary.

If we take the steppes of the left bank of the Dniepr, the arid steppe of the North Caucasus, and the southern Central Black-Earth Zone, we see that here the Gostianum 237 variety gives a superiority in yield of winter wheat over ~~summer~~ ^{spring} that is almost double. In some years the harsh winters may cause great destruction of winter wheat in these zones. But it is beyond doubt that with proper care in sowing, with observance of the rules of agricultural engineering, this destruction may be much reduced, if not brought to a minimum; and one must notice the complete inconsistency of the author who takes up the yield of winter wheat for the Volga region without considering agricultural engineering and measures for snow retention, both noted by the same author as very effective.

The problem of working out procedures of agricultural engineering and securing the yield for stable winter wheat varieties of the lower Volga region, Kazakstan, Western Siberia is so vital that it must be given

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more attention than it has received hitherto, and more than is shown in this book.

On the right bank of the Volga the relation between harvests of winter and ~~summer~~^{spring} wheat shows harvests of especially cold-resistant varieties of winter wheat are higher than ~~summer~~^{spring}, and very little disturbs the stability of the harvest. But the high and stable harvests of winter wheat are obtained here only under conditions of using pure fallow ground, and it is necessary to remember this, to practice this, in developing crops of winter wheat.

Artificial snow retention is also very important in the southern zone. On the basis of an analysis of numerous data -- the insufficiently detailed prewar data as well as the especially detailed and responsible data of the State Grading Bureau for the last 5 years -- one may draw a very clear conclusion concerning the south of our country, that the best varieties of winter wheat have a definite advantage over the best varieties we have now of ~~summer~~^{spring} wheat of 50-60 percent. Here we may, thus, decisively raise the question of strengthening the winter field through increasing the area under winter wheat with the introduction of the best varieties and necessary agricultural engineering.

The comparison of the harvests of kolkhozes, sovkhoses and individual farmers made in the book (part 2, page 51) convincingly makes the point that it is exactly the high-level agricultural engineering and seed grading which gives the huge difference between harvests on the experimental stations and sovkhos~~es~~^{es} plots and harvests of the kolkhozes, sovkhoses, and individual farmers. If we may take away 25-30 percent on account of grading, then the rest, ^{of the difference,} doubtless, ^{is due} belongs to improved agricultural technology. Therefore it is a completely wrong conclusion which one of the authors, A. A. Kornilov, reaches

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that "changing the variety of seed is the most effective and easily realized factor of the harvest." As the experience in practice of our kolkhozes and sovkhoses in the sowing campaign of 1933 showed, the most effective large-scale and easily realized factor in raising of harvest is precisely agricultural engineering.

The point of view in the scientific press, which attributes to seed selection the decisive role in raising the yield is not an accidental slip of the tongue. A number of plant growers, "selectioners," and agronomists, and also a number of practicing workers consider that agricultural engineering methods for increasing the harvest are not so effective as changing the variety, and they expressly give first place to selection completely forgetting that even the best varieties, having irreproachable qualities, give no results when put in unfavorable conditions.

On a field ploughed too shallow, on a field choked up with weeds and infested by a great quantity of pests, no variety of crop, not even the most splendid, can ensure even a mediocre harvest.

The not unknown Professor V. V. Talanov expressed the idea in this way: "Many of the improved methods of field cultivation -- deep ploughing, the application of fertilizer, transition to crop rotation, et cetera -- showing great possibilities for raising the harvest, demand, nevertheless, a great disruption of the economy with the introduction of new machines and more draft animals, and that is why these improvements will only slowly and step-by-step win their proper important place. In the reconstruction of our country's agriculture, the multiplication and mass dissemination of improved seeds involves comparatively little expense on the part of the government and the population. Already, for the very near future, this promises extraordinarily large possibilities, with the introduction of selected and generally improved varieties."

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This is written in a collection of articles on selection and seed cultivation in the USSR edited by V. V. Talanov. This point of view figures in one form or another in a number of articles in Plant Cultivation in the USSR, and completely contradicts those directives which wholly justify themselves in practice and assume that the first and most basic condition of high yield is the introduction of correct crop-rotation and exact observance of the rules of agricultural techniques for a given crop.

The second plan, which puts aside agricultural engineering as a "dearly costing measure" and linked with "the disruption of the whole economy," has led to a number of experts propagating the harmful theory of the superiority of shallow ploughing, maintaining, as though it were not possible, that deep ploughing is of no importance for the increasing of the harvest (Tulaykov, Rumyantsev, Sokolov, and others). Putting into practice this theory has led in a number of kolkhozes and districts to the fields being most barbarically choked with weeds, to the lowering of the yield, and thus has come the disastrous condition of a number of the kolkhozes, unable to fulfill their obligations to the Government and even take care of their own needs.

It is entirely clear that without the use of necessary agricultural techniques the best varieties are doomed to destruction, the shining example of which is the yield in the steppes of the Lower Trans-Volga, where the most cold-resistant varieties yielded a low harvest when measures for snow retention were not carried out. This influence of snow retention on harvest may be seen from the following data of experimentation on the ^{test} ~~general~~ plot in Saratov:

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<u>Variety</u>	Harvest (centners per hectare)		
	Without	With	Improvement in percent
	snow-retention	snow-retention	
	in centners per hectare	in centners per hectare	
Lyutestsens 01060/10	17.7	20.5	16
Lyutestsens 0329	13.4	18.3	37
Eritrospermum Eritrospermum 072/01	17.7	21.0	24
Gostianum 237	18.3	25.0	37

(part 2, page 67, of the original text)

We see that with snow retention the winter-resistant Gostianum 237 gave the maximum harvest -- 25 centners per hectare, and without it 7 centners less. If we take another test plot with still harsher conditions of wintering, we see as many startling results.

These examples show how wrong it is to take up the problem of varieties as abstracted from the application of the rules of agricultural engineering which are advisable and are the basic premise for raising the yield. Accordingly, in regard to the principal winter wheat regions of the Soviet Union, the conclusion must be drawn, that here winter wheat has all the properties not only for covering an expanded area, but also for a tremendous increase in crop yield. The more unexpected and incorrect are the conclusions which the author of the article on winter wheat presents to us (part 2, page 62), in claiming that further increasing the sowing of wheat is impossible, although this is only relevant to the zone of sufficient and fluctuating moisture of the North Caucasus.

Let us turn to the problem of the progress of wheat in the forest zone or to the problem of the progress of wheat in the north.

We are dealing with a task no less important and grandiose than that of irrigating the Trans-Volga region -- the sowing of approximately

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4 million hectares of wheat and obtaining no less than 300 million poods of wheat in the north.

The Party long ago set the objective, fully realizable, for Socialist farming, of transforming the so-called "consuming" belt of the Union into a producing area. Much has already been done in this respect, but the decisive reconstruction is still ahead. Numerous data on plots of the State Grading Bureau, and also currently gathered data on the kolkhozes and sovkhoses point to the fact that harvests of winter wheat in the north (Belorussian, Western, Lenigrad, Moscow, and Ivanovo oblasts, Gorky kray) considerably exceed the harvest of winter rye, and are in this zone sufficiently stable.

The enthusiasm with which the resolution of this problem has been carried out on the kolkhoz fields shows the great possibilities of swiftly realizing this objective in the very near future.

Already, in June 1933 at the plenum of the Moscow Committee of the VKP (b), the decision has been made to greatly expand the sowing of winter wheat in the Moscow oblast for this year, almost doubling last year's sowing.

Nevertheless, the introduction of wheat cultivation is a problem not only of huge importance but linked to great difficulties. It is necessary to overcome the inveterate prejudice against this crop. The impossibility of developing wheat cultivation under capitalism with small individual farming has left its mark on the psychology of the masses, who regard with suspicion its introduction. At the same time, advanced kolkhozes of the northern region have convinced themselves in real-life concrete experiences of the stability of the wheat harvest in the north, even greater than in the south. We must decisively overcome the injurious work of the class enemy, who carries on war by all means against the resolution of this very important problem in the struggle.

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The best variety of ^{spring} ~~summer~~ wheat in the north is Novinka. This variety according to data of the State Grading Bureau ought to occupy a very large arable belt, from about 57 to 62 degrees North in width. It is possible not only in the European part of the USSR, but also in the Asiatic part, for Novinka showed great stability and large harvest in conditions of the Far East, at the Amur selecting station.

At present, in the nurseries of the Department of Selection and Genetics of the All-Union Institute of Plant Cultivation, there are already new varieties showing an even higher yield than Novinka. ^(and which principally are hybrids of Novinka.) Especially interesting in their productivity are the ^{spring} ~~summer~~ forms, obtained by crossing with winter wheat. On winter wheat is also used extensive hybridization, preeminently of western Siberian varieties with the best selected varieties of the Union. Among the selected varieties of winter wheat at Detskoe Selo, one might point out D^S 2444 and D^S 2446.

Plant Cultivation in the USSR gives a huge amount of scientific material as the basis for a correct line regarding the progress of wheat into the north on a large scale. One must say, however, that the basic condition making this advancement easier is just that it is not linked to any especially great capital expenditure -- this is nowhere pointed out. It is shown quite correctly that the success of winter wheat is ensured by good fertilizer and the best cultivation, putting in the winter wheat after ^{plowing} ~~seasonal~~ and ^{following} ~~perennial~~ grass. Good fertilizer and improved cultivation, good preparatory planting by way of root crops or good grass -- all these are completely impossible under the conditions of small farming. The development of wheat sowing in the north is the result of the victory of the kolkhoz system.

The inadmissibly low reproduction rate of selected seeds has held up the beginning of wheat development in the north ^{and} ~~is~~ is a very unfavorable factor.

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The author of the article on the progress of wheat in the forest zone correctly points out that science is more backward in the field of developing agricultural engineering procedures for wheat sowing in the north than in the discovery of northern varieties of wheat.

In the article on winter wheat the so-called "basic line" for the development of the sowing of winter wheat is given completely incorrectly as: the displacement of rye by wheat -- the progress of wheat to the east and southeast, without mention of progress to the north -- the displacement of wheat in Central Asia by bringing in grain, etc. This line does not correspond to the factual material which is given by the same author, especially as regards the displacement of rye sowing. Doubtless on the best plots of land in the best districts, rye ought to give place to winter wheat. But one ought not to speak about the reduction of the area of rye as a whole, but only of transferring rye to other lands.

Speaking of the arid southern steppe of the Ukraine and Crimea, the author emphasizes that the "leading" place among grain crops ought to be kept for winter wheat, and blurts out that these districts can be considered to have reached the saturation point for winter wheat. This author completely ignores the possibility of raising the harvest. At the same time he arrives at the necessity of reducing the area under winter wheat (part II, page 54) in view of the increase in yield and the rise in its resistance to blight.

The line for filling the grain needs of Central Asia and the Trans-Caucasus is also given incorrectly, as a result of the lack of consideration of the great possibilities which exist for the development of wheat sowing on non-irrigated land in Central Asia as well as in the Trans-Caucasus, where local wheat sowing alone may fill a large part of local needs.

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The author also views pessimistically the progress of winter wheat in the Trans-Caucasus. The solution of this matter is made wholly dependent on the correct use of grades by the author, speaking little of new procedures of agricultural engineering. Thus, the mistakes of the Moscow and Voronezh Institutes of Socialist Reconstruction, which were sufficiently elucidated in our press in the matter of solving the grain problem, are spoken of in a number of articles in this book.

The question of the needed growth of the areas under winter wheat in the Central Black-Earth Area -- one of the most rapidly developing regions during the Soviet era -- is not emphasized.

A hypertrophy in questions of the use of varieties is evident in the following formulation of V. V. Talanov and V. P. Kuz'min: "The progress of wheat in the central part of our Union, in the Podmoskva and Ivanovo Oblasts, in the area of the right bank of the Central Volga in the Nizhenovgorod territory, northern half of the Central Black-Earth Zone, can come only with the successful solution by the selecting stations of the matter of introducing varieties resistant to the Swedish Fly and other unfavorable conditions."

There are a number of errors in this statement: firstly, not only on the solution by the selecting stations of the problem of varieties does the progress of wheat in these regions depend -- it depends also on the surmounting of prejudice, encouraged by the class enemy, that wheat sowing has no place in the north, it depends on the use of improved agricultural techniques. As for using the correct varieties, we already have these varieties, and V. V. Talanov falsely brings into question in this case types which we have and which have been proven under those growing conditions, which must be reproduced as rapidly as possible. Moreover, it is already established that a number of local high-yielding

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types of wheat may be widely utilized here.

Still more incorrectly it is asserted that a factor determining the possibility of expanding wheat-planting in the north is: "the value of maintaining imported wheat bread, since wheat is a large competitor for the best soils, which may be utilized for valuable crops -- ~~barley~~^{Flax}, barley for brewing, and others." Thus, the authors consider the increase in wheat sowing in the north as a temporary phenomenon, while transportation masters the problem of lowering the costs of importing bread from the south. This line completely contradicts the line of the Party and Government, and gets us absolutely nowhere.

As regards ~~barley~~^{spring} wheat, it is essential to especially emphasize the harmful prejudice against the "white spot," against which the Presidium of the Academy of Agricultural Science imeni V. I. Lenin took the opportunity to come out in opposition at the February session of the Academy in Voronezh, where it was very precisely pointed out that this prejudice is cultivated by those people opposed to the growth of Socialist agriculture and increased yield, who reflect and carry out the counterrevolutionary line of the class enemy.

The "philosophy" of the so-called "white spot" problem consists of holding back any increases in the sowing of ~~barley~~^{spring} wheat in those regions in which it has been hitherto little sown (Podmoskva Oblast, a number of regions in the Central Black-Earth Zone). The resolution of the "problem" has been postponed until that time when, supposedly, varieties will be introduced which will not be subject to the destructive activity of the Swedish fly.

Nonetheless, it is established that the effects of the Swedish fly may be substantially reduced by the use of improved agricultural techniques, together with measures for controlling weeds.

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The idea of the "white spot" is outlined in the following paragraph from the chapter on ~~summer~~^{spring} wheat:

"The demands on the basic ~~summer~~^{spring} wheat producing regions would be considerably less if we could expand wheat productivity in regions now importing wheat. Such regions are the forest-and-steppe part of the Central Black-Earth Zone, the Moscow oblast, the Nizhenovgorod territory and the right bank area on the Middle Volga. The areas under ~~summer~~^{spring} wheat are extremely small, owing to its low yield, not considering that farther to the north, the proportion of the sowing area under wheat is greater, from which it follows that the reason for the smaller area in these regions is not the shortness of the growing period, but some other factor. Among the most probable of those is the ordinarily widespread prevalence of the Swedish fly and larva, which, according to investigation of the Institute of Plant Protection and the Etymological Section of the former Saratov Experimental Station, is due in this region to climatic conditions favorable to this insect -- sufficient moisture and favorable temperature. Just as this district contains the belt of the greatest distribution of the Swedish fly, so further towards the southeast the dryness of the air hinders the development of this pest." (see part II, page 90).

Nonetheless, we have valuable practical experience in these districts, which showed that with the use of the simplest agricultural techniques, available varieties gave fully satisfactory average harvests. The possibility of expanding summer wheat production in our country is great, although selecting work in summer wheat, occupying two thirds of all wheat sowing, received much less attention than was the case with winter wheat.

In spite of our continental climate and arid regions, yet in regions not suffering from drought, in re-

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gions of sufficient moisture, with the same growing season as in Western Europe, we have a completely unsatisfactory yield of summer wheat.

Little consideration has been given also to the question of promoting ~~summer~~^{spring} wheat in such regions of completely satisfactory harvest as Belorussia, where harvests of wheat are not inferior to harvests in the Lower-Volga Kray, with much greater resistability. Belorussia, having a yield higher than the average in the USSR and equal to the average in the Russian Soviet Federated Socialist Republic, sows only an insignificant area of 40,000 hectares in summer wheat. One must say that, to the shame of Belorussian agronomists, very little attention has been given to this matter. Doubtless the wheat resources of Belorussia are by no means confined to 40,000 hectares. Data of the State Grading Bureau shows that the sowing area of ~~summer~~^{spring} wheat, as well as of winter, can be increased many times over in comparison to what we now have.

On the whole, speaking of ~~summer~~^{spring} wheat sowing, the authors do not consider it at all necessary (nor do the authors of the other articles) to emphasize, together with the importance of using the correct varieties, that agricultural techniques, and especially the correct timing of the sowing, are of decisive importance. One must say that, apart from comparing the low harvests inherited by our agriculture from Czarist times and the high harvests of other countries, not one author of those writing on ~~summer~~^{spring} wheat thought of stressing means of raising the harvest of ~~summer~~^{spring} wheat, all passing quietly enough past the low harvest which they are contrasting.

The matter of the ~~prospect~~^{prospect} of development ~~in~~ⁱⁿ sowing of oats is dealt with quite incorrectly. Together with a sound consideration of questions of practical farming, demanding an expansion of the area under oats and the raising of its yield, a shrewd consideration is in order, of

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whether Europe needs oats any more, of whether mechanization is reducing the number of horses, and if therefore the demand for oats is lowering. Such a putting of the question of developing the sowing area under oats may lead, of course, to insufficient pressure on developing this crop in a number of territories and republics where there are the most suitable conditions for it. The growth of the sowing area under oats ^{during} the Soviet ^{regime} appears as a kind of ^(spontaneous) process, ^{conditioned} exclusively by the fact that "oats are not a capricious crop" ^(since they) and grow on practically all combinations of soil and climate. Such a point of view is wholly opposed to our aim of planned management of agriculture. Our planning issues from the needs of the entire people's economy, for the USSR as a whole as well as for its individual territories and districts, and we do not permit the development of agriculture to be subject to the blind play of chance factors. In addition, it is erroneous to consider the cultivation of oats mechanically, abstracted from soil or climatic conditions and from agricultural techniques which are applied.

Some of those regions which are considered in all chapters of the book are extraordinarily large, often even exceeding a whole European State, and therefore for the workers planning our agriculture they are extraordinarily difficult to handle. A more detailed approach is necessary -- we need the publication of a *Plant Cultivation* for the individual regions of the Union.

A comparison of pre-war and present sowing areas is completely unreliable. Thus, in the article of Comrade Kovalev on the zoning of field crops (part I, page 60), incorrect data is deliberately cited on the sowing area in 1913 -- figures exaggerated by at least 10,000,000 hectares. Proceeding from such completely incorrect figures, the author similarly underestimates the scale of growth of our sowing area.

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Just as incorrect is the information on numbers of horses given in the article on oats (part II, page 74).

Reflected in this book are some completely harmful, discarded, bankrupt notions of "agricultural-industrial combines," including in these kolkhozes and sovkhozes (page 149, page 161, part I).

To the number of very crude errors we ought to add the program of sowing on a scale of 170 million hectares by 1937 in the article of P. P. Zvorykin, unsanctioned by the Government.

Extremely valuable is the large quantity of maps in Plant Cultivation in the USSR, specially prepared for this book and for the first time giving the geography of crop distribution in the huge area of our Soviet Union. Unfortunately, a number of the maps, once again, are based on obsolete material.

To this collection of valuable articles there should be added a weighty article on weeds and the fight against them. There should also be included some carefully chosen material on the forerunners of winter crops.

The book, we repeat, is a valuable contribution to scientific literature of material characterizing the natural regions of our country in a number of correctly planned dispositions of crops and types of crops on the fields of our Socialist agriculture. The abundant scientific material gathered in the book may be applied to conditions of any region. It is only necessary to remember the mistakes and defects of the book, far from fully and exhaustively noted by us (failure to coordinate crops and different grades of crops with social-economic factors; underestimation of the importance of agricultural engineering; incorrect posing, for a number of districts, of the question of developing winter and summer wheat sowing; and other matters).

Vice-President of the Academy of Agricultural

Sciences imeni V. I. Lenin

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PLANT CULTIVATION AS REGARDS AGRICULTURAL PROSPECTS IN THE USSR

N. I. Vavilov, N. V. Kovalev, N. S. Pereberzev

"The Soviet Union, from a land of small-scale and minute agriculture, has been transformed into a land of the strongest agriculture in the world on the basis of collectivization, ^{the} development of the sovkhoses and ^{the} wide application of mechanized techniques. This victory of Socialism, resolving the gravest and most difficult problems of the proletarian revolution, is important for the history of the whole world." (Resolution of the 17th Party Conference of the VKP(b).)

The huge successes achieved by us under the guidance of the Communist Party in the matter of industrialization of the country ^{open} ~~the~~ great possibilities of a full technical re-armament of Socialist agriculture and the furthest development and strengthening of Socialist agriculture.

Under the guidance of the working class ~~the~~ a real upheaval in ^{Soviet} rural life has been accomplished, lifting our people of poor and medium income to new, more complete forms of social life, ^{the} ~~name~~ of which is socialism.

"Thanks to successes of collectivization, the kolkhoz farmers in the basic agricultural districts have united 80-90 percent of the land formerly under individual tillage. A powerful net of sovkhoses has been organized. Agriculture has acquired more than 100,000 tractors." (Resolution of the 17th Party Conference of the VKP(b) and the Council of People's Commissars of the USSR of 29 September 1932.)

But these successes have given agriculture of the Soviet land the crucial task of fully providing the raw material needs for the furiously growing tempo of industry and satisfying the food needs of the population

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-- above all of the needs of the workers in our towns and new factories and plants.

Such tasks can only be fulfilled with maximum attention to the organizational and economic needs of the kolkhozes and sovkhoses, with day-by-day unrelenting work to fulfill them, and with a resolute struggle to improve the quality of our work -- in the broad conception of the word -- in all sections. In their resolution of 29 September 1932, the Council of People's Commissars of the USSR and the Central Committee of the VKP (b) especially emphasized that "the time has come when because of the growth in breadth of farming, through the increase in sowing area, it is necessary to turn to the struggle for the best tillage of the land, to the struggle for the raising of the yield, as the important and central task in the field of agriculture at the present stage of development." We need to increase the production of chemical fertilizer, we need to introduce in all the kolkhozes and sovkhoses crop management which has been tested as regards its techniques and its organizability, and especially we need machines to mechanize the tillage of technical crops and crops for ploughing under.

The course of the sovkhoses and kolkhozes in the raising of producing strength has been characterized by an important growth of the sowing area, by a growth of farming in physical extent. The sowing area in the USSR has grown 30 million hectares, over the prewar area. Especially notable is the growth of the sowing area under technical crops, plants for plowing under and fodder grass. It is enough to point out that the prewar area under cotton has tripled, ^{that} under beets and flax more than doubled, the area under sunflowers and maize has been greatly increased, and the area under annual and perennial grasses has been increased several times over. With this the goal of the first stage of the advance of agri-

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culture in our country -- the widest expansion of the sowing area -- has been already realized, and we are entering into the second stage of development of the sovkhozes and kolkhozes, a stage of struggle for a quantitative and qualitative rise in the yield of our fields.

But the struggle to improve harvests -- a very complicated and difficult task -- is linked with all questions of the most expedient spatial disposition of productive force on the huge territory of our Union, with all questions of correct organization of farming, application of all the achievements of agricultural science and practical experience, the rational and effective use of mechanized techniques, use on a wide scale of mineral fertilizer, the ~~schooling~~^{training} of experienced cadres, and so forth. Together with this is the task of raising the yield, that slowly evolving task, resolved by a systematic offensive, organized on all fronts, depending on the totality of controls and measures of the proletarian state.

One of the most important measures, permitting us to greatly raise the yield of our socialist fields, and realized only under the conditions of a Soviet land -- a land entering the period of socialism -- is the correct disposition of crops on the territory of the USSR. This disposition is now completely independent of the disposition of the productive forces of the entire people's economy, in general and -- in the first place -- from the industrial establishments. The problem of the most rational disposition of productive forces may be dealt with realistically only under a planned economy laying a firm foundation for the socialist construction of the country -- and the attempt of bourgeois economists to determine the so-called "motive forces" of the disposition of agriculture, the "evolution" of this economy, making the experience of its disposition independent ~~of~~^{of} the elements of the market in general

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and the local market in particular is an absolutely fleshless utopia.

Comrade Stalin has very clearly formulated the conditions which permit a rational disposition of the separate branches of agriculture in the Land of the Soviets, pointing out ~~that~~ ^{that} under the system of small peasant farming, seriously practicing specialization is impossible, since small farming is unstable, without the necessary reserves, and compelled to take on any and all crops, so that in case of a failure of one crop it may turn to another. It is also clear that without maintaining known grain reserves in state hands it is impossible to bring up the matter of specialization. Now, when we have converted into an economy of large-scale farming and secured in state hands our grain reserves, we may and ought to set the task of properly organizing specialization in crops and branches of agriculture." (16th Congress, VKP(b))

The basic line, then, is this -- bringing industry as close as possible to the sources of raw materials, decisively raising the industrial level of backward national districts of the USSR -- which in this case coincides with the task of bringing industry nearer to sources of raw material -- complex utilization of natural wealth, supplying the country with the most important kinds of agricultural raw material so that we may realize complete economic independence from foreign states.

Surmounting difficulties, sweeping from the way the furiously opposing class enemy and his agents, the proletariat under the guidance of the Party has victoriously realized Lenin's plan for the industrialization of the Soviet Union.

We are covering the land with a net of mighty electric power stations. We are building all the time more and more new industrial combines, which will be the prevailing pattern for our socialist industry.

Very large industrial centers have grown up, processing industries

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developing around metallurgic, coal, oil, and other industrial establishments, and brought the need of a corresponding development around the different kind^s of agriculture, conforming to the crops available.

A real reconsideration of specialization in agriculture and the allocation of crops which we have at present is in order, although during the last 5 years important corrections have already been introduced, for collectivization and sovkhoz construction in the Land of the Soviets have proved far more powerful factors than agricultural economists of the capitalist countries ever supposed. For the last two years alone (1930-1931), the sowing area has increased 18 million hectares, an increase which would have taken decades on the old scale of development. It is important to note that such an increase proved to be possible even at the very beginning of the development of collectivization and sovkhoz construction, when the production of tractors and other machinery far from satisfied vital needs. The past years of the First Five-Year Plan showed for the first time the exceptional plasticity of plant cultivation, the possibility of carrying out large-scale changes in a short period, quantitative as well as qualitative, in socialist agriculture.

Let us take, for example, cotton, as one of the most important crops. Before our eyes, in some 3 or 4 years, changes have taken place which would have formerly demanded many decades, if not whole centuries. The sowing area under cotton plants increased in four years three times over in comparison with the highest prewar figures. In spite of doubts still expressed 3 or 4 years ago, cotton production has now become consolidated in new districts: in the southern part of the Ukraine and in the North Caucasus, where in the current year the sowing area under cotton reached 400,000 hectares. Doubts of the adaptability of high-quality Egyptian cotton within the Soviet Union were also shattered by the experience

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in practice of the last two years -- in Central Asia Egyptian cotton already this year occupied more than 52,000 hectares.

Allocation of crops is this: the concurrent allocation of grades ^{and the} exchanging unsorted seeds for selected material. Success in the introduction of a crop usually depends above all on choosing suitable seeds. An understanding of crops is inseparable from an understanding of varieties.

The available supply of types of agricultural plants -- as well as that of breeds of livestock -- cannot be considered satisfactory for large-scale specialized socialist production, based on maximum use of mechanical and chemical methods. Even for the basic field crops we do not have ideal varieties. In wheat, to which 37,000,000 hectares were given over, we have had up to now defects even in the best varieties: we do not have sufficiently winter-resistant forms, ^{and} ~~no~~ varieties sufficiently drought-resistant.

Setting an objective of the maximum acceleration of the introduction of new varieties, we may, nevertheless, already cull from the available selected reserve sufficiently proved grades, the use of which guarantees us an important rise in the harvest, and may give the country an additional ten million centners of wheat and other achievements in yield. Few people know that in 1931 we had on our fields, in five basic crops, more than 150 varieties (21 in rye, 37 in winter wheat, 38 in ~~spring~~ ^{spring} wheat, 28 in oats, 29 in summer barley). It is doubtless true that such a multitude of varieties renders exceptionally difficult the organization of plant cultivation, the replacing of one variety with another, the standardization of agricultural engineering procedures ^S, the storage and especially the export and industrial processing of agricultural raw material.

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In the very next years we may and must introduce standards in all crops, inasmuch as, at the present time, material has been already fully prepared by the State Network for Experimentation in Varieties for the majority of basic, leading crops and particularly in wheat food and forage crops -- in which a very ^{great} ~~large~~ further increase in sowing area is outlined.

Solving the wheat problem, strengthening the further qualitative and quantitative growth of wheat farming, we may carry out the transformation of cultivation responsible to the needs of industrial construction, with the maximum utilization of all soil and climatic differences of each individual district.

One must remember with this that the material given to us in the following exposition on the possibility of changing the area given to this or that crop, instructions on the necessity of its progress or transfer, are not only and not as much rough drafts for the expansion of the sowing area in our country as indications of a possible rise of productivity on lands already involved in agricultural cultivation, not losing sight, also, of its great prospects for further quantitative growth.

Here, above everything, it is necessary to harshly bring up the question of decisively ousting inferior crops from the more valuable districts of our humid and arid subtropics, of which the People's Commissar of Agriculture USSR, Ya. A. Yakovlev, spoke further at the 16th Congress of the VKP(b). Our subtropic zone is limited, but because of this we ought all the more to use rationally each square meter of this area available for the cultivation of the most valuable plant raw material, now imported by us from abroad. An expansion of the cultivation of plants which yield raw material of which we now have a deficit, plants in the majority of cases new to us, is an agricultural objective far from unim-

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portant. Among such plants, in the foreground of importance are plants giving natural rubber. Already, in the very next years, the cultivation of tau-saghyz, guaula, chondrilla, the Crimean dandelion, etc., may allow us no less than 50 percent of the rubber needs of our country. The previously completely unresolved problem of obtaining rubber for the fatherland has thus been solved on a large scale with the introduction into cultivation of new plants, still unknown to our agriculture three years ago.

The question of introducing new crops ought to be given special attention, in which to our understanding, the problem of new crops is indissolubly linked to the broad utilization of the whole world's growing resources, with mobilization of the plant resources of the entire globe.

Research of recent years has revealed the presence of huge plant resources in various ancient southern mountainous agricultural countries. The differences between the peoples and the routine which ruled agriculture created a barrier to the utilization of experience of the separate peoples and separate countries. The large number of different views on the crops cultivated in the various countries were until recently little utilized in the USSR. Such crops, for example, were American corn, African sorghum, Sudan grass, the American sweet potato, the early-ripening Japanese variety of rice, the soybean, the tea plant, ramie, gambo hemp, and various aurantiaceae.

In the problem of new crops we also include questions of the progress of crops in new zones, the objective of moving crops towards the north, linked to the adaptation of agriculture to northern conditions and the maximum utilization of our valuable zones of the humid and arid subtropics which we have already noticed.

Huge possibilities lie in the vast expanses of Siberia, still

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unmastered by the proper methods of cultivation, those of the great land spaces of the Far East, especially its Pacific littoral. We refer here to the utilization under cultivation of the extensive, now vacant spaces of Central Asia, Kazakstan, and the southwest of the European part of the USSR, the assimilation of which depends upon our discovery of new crops.

The great problem of the struggle against drought has been already brought up by the Central Committee VKP (b) in their resolution concerning the irrigation of the Trans-Volga region, where we have the opportunity to secure an irrigated area of 4 million hectares, to be given over primarily to wheat. But this same problem demands of us that we bring many more drought-resistant crops into the east and southeast. First we ought to bring such crops as sorghum, millet, Sudan grass, sweet clover, yellow alfalfa, the sunflower, corn, and than more drought-resistant varieties of ~~summer~~^{spring} wheat. These crops have new places on areas each of several million hectares. Simultaneously the utilization of our waste-lands and semiarid lands ought to be organized -- not only by means of irrigation, but also by more extensive and sufficiently effective methods, remembering that irrigation may take up millions of hectares, but the waste and semiwaste areas available to us number many tens of millions of hectares. The utilization of these wastelands as pastures, with a different approach to each and with the production of seeds of wild plants for barren lands -- hitherto neglected -- is wholly possible.

A Bolshevik resolution of the problem of the struggle against drought is the most important task lying before Soviet agriculture. The vastness of this problem comes from the fact that the huge sowing area of our basic producing districts (the Middle and Lower Volga, the North Caucasus, Western Siberia, Kazak^hstan, the south of the Ukraine) are in the zone of insufficient moisture and in the drought zone (Central Asia). As a

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result of almost yearly ~~severe~~ droughts, we "regularly" lose on our fields 10-12 million centners -- and in especially arid years no less than 100 million -- of harvests in grain crops alone, and we have colossal losses in all parts of the national economy, affecting agricultural production in the southern part of the USSR.

The problem of the struggle against drought could not be brought up on so wide a scale in Tsarist Russia, and the solution of this problem is within the power only of the proletariat, building a new world. In fact, we have before us, the systematic carrying forth not only of a whole complex of agricultural engineering measures in this or that crop, but also transferring crops themselves, and varieties of crops, on an area of some tens of millions of hectares, and introducing on a large area new technical, wheat, and food plants. We will realize vast projects in the utilization of our water resources, for radical amelioration on a scale hitherto unseen. This involves change and systems and patterns of agriculture of every separate zone, with their subordination to the general interests of the entire people's economy of the land.

The resolution of the Central Committee VKP (b) and the Council of People's Commissars of the USSR concerning irrigation of the Trans-Volga area already mentioned above, is large and important for the people's economy of the USSR, giving stability to the agriculture of those districts. However, in all its vastness, it is only the beginning of work in the struggle against drought, inasmuch as the developing ^{of} industrial and power construction in the Volga, Kusnetsk Basin, Karaganda, and other districts gives a new basis, a new starting point for the struggle against drought.

Plant cultivation in the arid zones of the USSR ought to be in the very next years changed in a radical manner, freed from the prevailing pattern of drought.

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In prospect for not many years hence we will have available several million hectares of fields, on which a very prominent place is allotted to summer wheat. Its varieties themselves have only recently been determined, and it is possible that there will be a completely different type of wheat than those which we are accustomed to see on the fields of our arid zones. Next in importance of the crops are corn, and, especially, alfalfa, as an obligatory component of wheat crop rotation of irrigated farming.

But in addition to the irrigated districts there will still remain the vast expanses of the Lower Volga, the south of the USSR, Western Siberia, Kazak^hstan, the North Caucasus, and other regions. We will send to these areas more drought-resistant varieties of summer wheat of Soviet selection, which has the job of utilizing in hybridization seeds from semiarid districts of Syria, Palestine, Algiers, Persia, and other lands, with the aim of introducing new, more drought-resistant forms of summer wheat.

Large areas in the arid zones of the USSR may be assigned to millet, transferring its present area from the humid districts of the Central Black Earth Zone and the forest-and-steppe area of the Ukraine to the Volga area, Kazak^hstan, and Western Siberia.

Of the perennial crops, the sunflower ought to be promoted on a broad front. If several years ago one might still have doubted the possibilities of cultivating the sunflower in the arid districts of Kazak^hstan and Western Siberia, experiments in recent years have shown the complete feasibility of sunflower cultivation in these districts, especially with the selection of appropriate varieties and introduction of new early-ripening forms suitable for mechanized harvesting (of the "dwarf" type). The sunflower ought to be a basic perennial crop in the unirrigated arid zones of Western Siberia and Kazakstan.

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Corn also shows great prospects for progress in unwatered arid zones. Although it is a crop which is only relatively drought-resistant, it may be advanced considerably further to the southwest than it is at present. Here, corn now already yields in dry years a wheat harvest of 5-8 centners per hectare as against 1-2 centners of wheat and barley. And since corn is very flexible, one may, by means of selection, choose forms for arid districts with a much higher yield than those we have now.

Besides those crops which we have noted, more drought-resistant leguminous plants ought to be promoted: the chick-pea, the French lentil, the kidney bean.

Our arid zone, especially its southeast part, is a basic live-stock raising zone. In this connection, there is the problem here of organizing a firm fodder foundation. Among fodder crops we have such plants as *zhitnyak* ^[*Triticum cristatum*] and yellow lucerne, and then sweet clover, Sudan ^{ss} ~~grass~~, and sorghum, which permit us to consider the question of organizing fodder ^{bases} ~~foundations~~ for the arid zone as technically solved. Sweet clover *zhitnyak*, and yellow lucerne ought to be put first in order, being more drought-resistant crops, and, in addition, being components of crop rotation, improving the physical properties of the soil of arid zones and raising its fertility. Special attention ought to be given to sweet clover, which is a very salt-resistant crop and makes excellent pasture land lasting from early spring until late fall, and gives a not inferior hay and good material for silage -- therefore, with wheat and the sunflower, it may be noted as an obligatory component of crop rotation. Sorghum -- this "camel of the plant kingdom" -- is an exceptionally drought-resistant crop, and its cultivation for grain ought to find a place for itself on several million hectares in southern Kazakstan, Central Asia, ^{Ydzh} Azerbaijan, the Kuma River area, the Crimea, and in the south of the USSR --

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and in more northern districts for green fodder and silage. Sudan grass, of the annual grasses, is also an important fodder crop, and, though it is less drought-resistant than sorghum and sweet clover, it still gives even in arid zones a harvest of up to 20 centners per hectare.

Again the problem comes up of the struggle with drought, the conquest of our vast empty spaces. Hundreds of millions of hectares in our land are occupied by sandy, clayey, and rocky wastes. We must begin an offensive against barren lands, we must utilize if only half of the our empty expanses for pasture land, for crops of drought-resistant grasses, and for artificial afforestation. For Turkmenia, Uzbekistan, ^{and} Tajikistan, and Kazakhstan, the struggle with barren lands is a matter of first importance. Here, barren lands surround towns, squeeze in not numerous oases of cultivation.

In the wild flora of the semibarren and even barren districts of Kazakhstan, the Lower Volga area, Central Asia, and lands contiguous to these, are reserves of valuable wild drought-resistant fodder plants. Among these flora are various saltworts, *zhilnyaki*, meadow grasses (*viviparidae*), wormwoods, astragali. Bringing into cultivation of several of the native Central-Asian psamophytic desert and semidesert plants is very tempting and feasible.

Of agricultural methods aimed at ameliorating the climate of arid zones, we will carry out afforestation on a huge area. Here also we ought to notice the drought-resistant shrub types of the barren and semibarren areas of Central Asia, rich brushwood and wood types, noteworthy for an extreme resistance to heat and drought. Among these there are plants very valuable for cultivation, giving prospects of wood for construction or small jobs, deserving the widest distribution.

In addition to the struggle for a highly productive and stable

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agriculture in our continental land, the matter of advancing agricultural cultures into more dependable, more humid northern districts comes up with a special sharpness.

One of the basic State measures in the very near future in the struggle against drought, so frequent in our black-earth steppe regions, is a radical change in the geography of agriculture, advancing it into more northern, sufficiently humid zones.

Acclimatizing agriculture to northern conditions is one of the immediate objectives of our national economy.

The most essential factor determining the expediency of moving agriculture in a northward direction is the stability here of the harvest, because of the absence of drought -- less dependence on the year's weather conditions. If we turn to a historical geography of the yield, even in usual conditions, with practically archaic methods of cultivation, harvests of the northern districts have greatly surpassed and are now surpassing harvests of the basic southern agricultural districts. Thus, the harvest of winter rye for the region along the Volga is 6.2 centners per hectare, but for the Northern area 8.2 centners -- i.e., 25 percent higher. The barley harvest in the north is almost twice that of the barley harvest in the region along the Volga.

Still more striking results are received with the application of necessary agricultural engineering methods. Thus, for example, the average harvests of rye on the Moscow experimental field reach 27.2 centners per hectare, while on the Saratov experimental field the average size of the rye harvest, under the very best conditions, reached only 18.9 centners. Winter wheat under conditions in Kherson gives a yield of 15.6 centners -- and in Moscow 25.2 centners.

Sharper differences are apparent in ^{spring} ~~summer~~ grain, especially

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subjected to the action of dry winds in the south. Thus, while in ~~Kherson~~^{Kh} the average harvest of barley on the experimental field is 8.7 centners per hectare, in Vyatka it amounts to 19.1 centners, in Minsk 18 centners, in Nosovka -- in the north of the Chernigov area -- 31.9 centners. Harvests of ~~summer~~^{spring} wheat are 30 percent higher in the north than in the south. It is in the north that the maximum harvests are definitely obtained. It is precisely the northern districts that give the highest harvests in the world in grains. Harvests in Denmark are on the average four times greater than in our land, and soil conditions in Denmark are not at all better than ours. Average harvests of winter wheat and barley of 34 centners and higher per hectare have been customary for many years in the best Danish agriculture, agriculture which is concentrated between 54 and 58 degrees North. Northern Germany, with its poor podsollic soil, is also noteworthy for exceptionally stability and highness of harvest.

How great the possibilities are in this respect the experience of the Khibini station of the Institute of Plant Cultivation very clearly shows. Thanks to seed selecting -- applied to the world's huge assortment of varieties -- under conditions of normal intensive cultivation with fertilizer, the following average harvests were obtained for a number of years:

	Average Harvest	
	in centners per hectare	Number of Years Recorded
Potatoes	309	5
Head Cabbage	345	5
Turnip (<u>Brassica napus rapifera</u>)	700	4
Carrot	113	3
Turnip (<u>Brassica rapa</u>)	358	5

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Stability of harvest through the years is a characteristic feature of the north, as contrasted with the arid south.

It is very essential to note also that the most favorable districts of the USSR for fiber flax, for potatoes, for fodder grasses, and for rye pertain to the northern non-black-earth regions. The very highest-quality flax in the whole world is concentrated precisely in our northwestern and northern belt, not black earth land, around 61 degrees North -- in the regions along the Sukhona and Vychegda Rivers, around Severo-Dvinsk. Maximum harvests of the highest grade of potatoes are also obtained in the north. The best brewing barley gravitates directly towards the northwestern regions of the European part of the Soviet Union. The maximum harvests of root plants -- the mangel-wurzel, ~~the~~ turnips (Brassica napus rapifera and Brassica campestris rapifera) -- are obtained in the non-black-earth belt. The humidity, the great amount of precipitation, the cloudiness give to the north especially favorable conditions for plant cultivation, in which vegetative organs are primarily used (the potato, root plants, grasses, flax, hemp, vegetables). For-est argillaceous soils give a high wheat harvest. Of the oleaceae, mustard and false flax do well in the north. The sunflower gives a huge amount for silage in the area around ⁿLenigrad. The wide distribution of sugar beet cultivation in Denmark and Sweden demonstrate the possibility of its acclimatization to northern conditions in our land. Geographic experimentation in cultivation of the sugar beet, carried out in recent years by the Sugar Trust, corroborate the practical experience in Western Europe that it is adaptable to northern conditions.

Agriculture has hitherto gone along the line of least resistance concentrating on the black-earth and brown soils, which need no fertilizer or amelioration. The time is arriving -- has already arrived -- when the Soviet land ought to bring up the problem of acclimatizing agriculture

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to northern conditions, on a scale corresponding to its importance.

Agriculture is possible in the North, there is no doubt of this, but positive results are obtained here only with considerable labor, with use of fertilizer, with carrying out of draining work. For northern soil with its surplus moisture, drainage of the fields is an essential condition of cultivation. As a rule, the higher the water permeability of the soil, the higher the harvest. Denmark, where the highest harvests in the world are obtained, has almost completely drained fields, as does southern Sweden.

Extraordinarily little attention has hitherto been given by us to matters of drainage of northern soils, yet its importance is very exclusively in conditions of surplus moisture, for winter-proofing soil and aerating it as well as for the proper timing of sowing and harvesting. In Western Europe and to some extent in North America, drainage is considered necessary in years when the amount of precipitation exceeds 500 millimeters.

Liming, fertilizing the soil, and drainage are the basic premises for the development of agriculture in the north. In the future, a great role in northern livestock development ought to be played by manure fertilizer, the importance of which we clearly do not appreciate. One must remember that even in such technically advanced countries as Denmark the main amount of nitrogen and potash are introduced into the soil by fertilizer. Despite the very great rise in imports of artificial fertilizer, fertilizer still gave the soil almost 75 percent of all its nitrogen and potash and more than 30 percent of all its phosphorous acid. Development of the production of fertilizers in the near future will make possible utilization by us of mineral fertilizer not only for such interesting crops as cotton, beets, and flax, but also in grain cultivation

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on northern podsollic soil. The high harvests of grain crops in neighboring western countries above all calls for a wide application of mineral and manure fertilizer. It is very essential to take into consideration the improvement in quality of manure fertilizer in connection with the great use of oil cake as fodder for livestock. The fertilizing role of manure in the last decade, as Swedish and Danish experimental institutes have ascertained, has doubled compared to the previous decade, with the intensive introduction of oil cake as fodder.

The use of amelioration, liming, and fertilizer opens up wide possibilities for utilizing swamps and unfavorable sandy lands of the north. In this connection the experience of neighboring countries is especially instructive: a quarter of all the cultivated land in Finland, a whole 500,000 hectares, represents swampland brought under cultivation; a quarter of all the cultivated land in Denmark, yielding the highest harvests, was still unfavorable land 30 years ago, *vereshchaki*, swamps, empty expanses, all under water.

Thus, in the struggle against drought, in addition to large-scale irrigation-projects for the Volga, the Amu Darya, and the ~~Dnepr~~ *Dnepr* there is the still vaster objective of acclimatizing agriculture to northern conditions.

Moreover, for other reasons agriculture may and ought to be advanced to the extreme circumpolar north.

The defense of the far north is difficult when agricultural products are imported. The development of advance posts of agriculture in the far north is a matter of urgent necessity, dictated by the interests of the whole Socialist construction of our land. In the near future, the Great Siberian Waterway ought to unite by the shortest route the Arctic, Atlantic, and Pacific Oceans, to cut through the Siberian tayga and come

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out on the Okhotsk Sea.

Our principal forest wealth is concentrated in the Far North. Of the general forest area of the Soviet Union, established at 900 million hectares, 700 million hectares are Siberian forests, which are shipped out on the Siberian railway and floated down the Ob and Yenisey. The huge expanses of forests of Siberia and even the European part of the USSR are still unutilized, destroyed by forest fires and winds. Assimilation of the colossal forest and metal wealth of Siberia, development of livestock raising and the fishing and hunting industries in the Far North, utilization of the waterpower of numerous rivers, construction of railroad, water, and air means of communication, securing the shortest routes, are obligatory for uniting the continents; all this is demanded by the urgent necessity of expanding and developing agriculture in the circumpolar Far North.

Certain crops, in the Old as well as the New World, grow as far north as the Arctic Circle and even farther. In Norway, barley, oats, ^{spring} ~~summer~~ wheat, and winter rye have been grown for many centuries between 70 and 69 degrees North. In Sweden, barley, with inland conditions, grows up to 68.3 degrees North. In Canada, grain crops reach the Arctic Circle. Within the Soviet Union certain crops also reach the Arctic Circle: on the Pechora River cultivation is carried on up to 66 degrees North, in Yakutia there were various trials of barley, oats, and even ^{spring} ~~summer~~ wheat cultivation as far north as Verkhoyansk (67 degrees 30 minutes North).

In the course of the last seven years, the Institute of Plant Cultivation carried on the so-called "geographical experiments" throughout the whole Soviet Union. 40 different field crops were taken, representing 185 different varieties. A portion of the experimental spots

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were concentrated in the extreme Far North, on the Kola Peninsula, in Khibini (67 degrees 44 minutes North), on the Pechora River in Ust'-Tsylna (65 degrees 27 minutes North), in Archangel (64 degrees 33 minutes). These experiments showed very definitely that winter rye, barley for seed, and winter flax may be cultivated in the European part of the Soviet Union even in Khibini at 67 degrees 44 minutes North. Winter wheat and winter rye have reached 65 degrees North. Except in some especially unfavorable years, early varieties of wheat ripen even in such northern latitudes.

The line of furthest northward penetration of bread crops depends on different conditions; it may change directions, be unequal to the various latitude lines. The line for bread crops depends on the warm currents, which reach the shores, moderating the harshness of the climate as regards its continental qualities, determining the ripening time of varieties brought under cultivation. In general, the boundary below which the earliest varieties of bread crops ripen may be considered to be the latitude of the Arctic Circle (65 degrees, 30 minutes North).

The majority of vegetable crops, including the potato, as the whole world's experience has shown us, have in actual practice no northern boundary. The potato, the turnip brassica rapa, the turnip brassica napus rapifera, the carrot, the cabbage, the onion, the beet, the horse radish, the radish, and many other vegetables, grow as far north as the Arctic Ocean, to the most northern point of the European continent, Nordkapa (78 degrees, 18 minutes North). The radish has been successfully grown even in Spitzbergen (78 degrees, 30 minutes North). Last year, the Institute of Plant Cultivation established hothouse crops of vegetables on Novaya Zemlya. Crops of vegetables were fully successful

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in Murmansk, in Khibini, around the mouth of the Yenisey, in Verkhoyansk, in the area around the lower River Kolym, on Kamchatka. With the work of the Khibini station, the Archangel experimental field and the Pechora station -- and in America with the experimental institutes in Alaska -- obtaining large harvests and an excellent quality of vegetables at the Arctic Circle was made possible.

Grass sowing also may reach the Arctic Ocean. Our geographic experiments have shown that the productivity of the vegetative mass increases towards the north -- plants become taller and further developed. Even timothy seeds ripen at the Arctic Circle. At the Arctic Circle grow bromeless brome grass, meadow fescue grass, foxtail grass, and bent grass. Oats and barley do excellently for green fodder. Freezing of the soil, not infrequent in the Far North, does not hinder agriculture. The top layer of the soil is melted by the summer and growing crops is then quite possible. As regards freezing of the soil, one must consider not the depth of the freezing, but the depth of the summer thaw.

Study of the geographical limitations of agriculture definitely show that continental climate is more favorable to northern agriculture than a littoral climate. Although the latter is characterized by a milder winter, in the summer the heat is insufficient. While on the western coast of Norway at 67 degrees, 30 minutes North the average temperature for June-July is 9 degrees Centigrade, in Verkhoyansk in continental Yakut^{sk}ia, at the same latitude for these same months the average temperature is 14 degrees. The well-known climatologist A. I. Voe^ykov established the general proposition: the higher the latitude, the harsher the climate, and the harsher the climate the more the continental climate has an advantage over a littoral climate for agriculture.

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Thus, on the territory of the Soviet Union, agriculture has in actual practice no northern limits. The cultivation of vegetables, root plants, tuberous plants, and fodder grass may go to the very northern limits of the Eurasian land mass, not only to northern limits of the tayga, but into the forest-tundra belt and even the tundra.

The geography of agriculture thus changes, and, as regards the problems facing the people's economy of our country, the role of various crops and groups of similar crops doubtless also changes.

Under the new economic system, the old crops become essentially completely new crops, compelling a new approach to them.

The new socialist system demands large-scale changes in our usual ideas of plant cultivation. The development of industry side by side with agriculture, the industrialization of agriculture, changes the purposes for which different crops are grown. Already in the very near future, hundreds of thousands of hectares of potatoes will be used for obtaining rubber, prepared from potato alcohol. It is very probable that corn and grain sorghum will also be used for this purpose.

We are faced with the problem of utilizing straw from our bread grains for paper manufacturing.

The time has come for widespread utilization of our plant waste products in industrial production of fertilizing humus, which, with the method of A. Govard, greatly surpasses manure in effectiveness. The huge expansion of vegetable crops, the laying out of new orchards, and the concurrent shortage of fertilizer, the manufacture of valuable fertilizing humus from straw waste products, cotton plant stems, sunflowers, etc., especially attractive.

A factory for extracting casein from the soybean has already been constructed. It is also possible to utilize in this respect other grain

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leguminosae. Cottonizing may be applied much more widely to hemp and kenaf.

The technical improvement we have begun allows us to make use of old crops on a large scale. Our revolution in agricultural engineering even extends to using airplanes for sowing rice, bread, and fodder grasses, and changes our whole approach to cultivation. The very laborious ancient cultivation of rice has before our eyes become more mechanized cultivation, with the use of airplanes for sowing and combines for harvesting. Rice becomes, in conditions of mechanized agriculture, a completely new crop. The substitution of tractors for cattle and the introduction of combines permit us to expand sowing in the more arid districts, allowing us to take great risks in semi-arid regions, in utilizing arid zones. Introducing linen and cotton-picking machines changes the fundamental scale of computing work applied to these crops.

An important role is allotted to sweet lupine (unalkaloid), which, having 40-50 percent albumen, is equally valuable as nourishment for humans and for livestock, the latter receiving albumen in the form of wheat, green fodder, pasture food, and silage. This year we already have home-grown selected sweet lupine with alkaloid content of 0.027 percent, growing well on plots of 2-4 hectares. In several years we can have hundreds of thousands of hectares of such lupine.

We are dealing with many crops with very complicated objectives in mind, with hundreds and thousands of varieties, forms, and patterns available to achieve these objectives, and hence we have material for practical use and in addition much material left over for selection. Yet other crops seem still poorly differentiated, and we are putting under cultivation not even ecotypes but complex populations. Work of botanists is needed here, and many unexpected discoveries await "selectioners."

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Experience in work with lupine has shown that in one and the same form, outwardly quite the same, we find -- though, it is true, very rare (1 in 50,000-200,000) -- containing absolutely no alkaloids, or containing them in completely inconsequential quantities. Thus it appears that the biochemical properties of plants are not always fully evident from the

^{habitat} of the plant, from its form, and that in research on the quality of plants with different contents of albumens, fats, and alkaloids, we ought to deal with them in an individual way ^{along} ~~very~~ pure biochemical line.^s

After lupine, we turn to research in coumarineless sweet clover, the castor plant, and cotton, which do not preserve in their seeds and in oil cake poisonous substances, to an individual determination of the fat in a single wheat (sunflower, linen, etc.). We must find ways to determine the amount of fat without lowering the vitality of a given specimen of seed.

We need a general revision of the classifications of species and varieties of our cultivated plants. The wheat of the future will probably be different from that of today, for the "selectioner" has already begun to revise not only the varieties but also the species of wheat, and this opens up interesting prospects. Let us point out some of them.

Seeds have shown reactions to light (photoperiodism) and reaction to pre-sowing processing with low (for wheat, etc.) and high (for plants having ^theaf affinity -- cotton, panic grass, etc.) temperature; the application of this method of treating seeds, discovered by T. D. Lysenko, is known as vernalization. It has now already changed many of our suppositions about plants and varieties. Very late varieties of ^{spring} ~~summer~~ wheat, subjected to pre-sowing thermal processing while they were sprouting

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were found to ripen much earlier than very early varieties of the south of the USSR (the Ukraine). In conditions of our southeast, there where we never have had English wheat in the field -- for fall sowings are frozen out, owing to their late ripening, and ears do not appear, it is possible with the use of vernalization to raise completely normal large-eared English wheat (Triticum turgidum). Winter varieties are transformed into summer, late into early. Things which it was once impossible to do with the world growing assortment are now actual facts. This method again reveals to "selectioners" possibilities of plants hitherto unnoticed. It also has great value for practical farming, permitting us to keep the plant from unfavorable conditions of drought, the first autumn frosts, etc.

We must already take into consideration that in the vast problems of irrigating the Trans-Volga region the method of vernalization gives the possibility of utilizing the most productive world varieties, including English wheat. It is very probable that even by simply reviewing (taking into consideration the application of vernalization) the world assortment which we have as a result of Soviet expeditions it will be possible for us to select new valuable forms ready for different growing conditions, better than those cultivated at present. As regards the utilization of the world assortment for hybridization, a completely boundless horizon of interesting practical work is opening up.

This same light reaction of plants to the length or shortness of the day shows great possibilities. This reaction gives us the possibility of introducing a number of plants into cultivation in the north which grow quickly in the long day and do not under present growing conditions give sufficient yield production (lettuce, radishes, and several other of the mustard family). Also, we may by shortening the daily illumina-

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tion force perennial tropical cotton plants to flower and bear fruit under our conditions. We may obtain, for example, at any time of the year and in a short space of time flowering chrysanthemums. Moreover, we have the possibility of giving winter-resistability to plants subject to a light reaction, by shortening the day. And in a number of cases this winter-resistability was, for many species, transmitted to succeeding generations by vegetative propagation, apparently as a lasting modification. We thus are nearing management of the plant organism, and that which still two or three years ago seemed final, simple, and clear must be reviewed in the light of the newest discoveries, giving great new perspectives where we were accustomed to see a blind alley.

In addition, plants have been revealed to react very differently to fertilizer, and the contemporary "selectioner" must in a number of cases select plants which best assimilate one kind of fertilizer.

Even these very isolated examples are enough to prove that the social premises set forth by the whole structure of the Soviet Union give the possibility of socialist reconstruction of the entire people's economy of the land. They permit us to organize our agriculture in a modern way, converting it to a large-scale, specialized economy constructed on a new dynamic base (collectivization, sovkhozes, MTS's). They permit us to replan in a modern way the disposition of crops and varieties of crops, transferring them in the interests of the people's economy onto areas of tens of millions of hectares. And at the same time, scientific discoveries in the field of biology permit us to approach anew the management of the plant organism, to modernize methods of agricultural engineering, bringing us thus to a more rational utilization of natural possibilities in general and plants in particular.

The Soviet Union possesses keys which the world has never before

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known. A new chapter in the history of agriculture is beginning. We have reopened the problem of utilizing the plant resources of the world.

In this book we sum up, for every crop, certain of the results of the past year's work, results accumulated both in practical experience and in the experiments of research establishments, trying to mobilize all those deserving attention, and also taking note of the first stages of the planned allocation of crops and varieties on the territories of the USSR.

Our aim in publishing this book is to give raw material for the construction of a plan for plant cultivation in our Soviet land, and, simultaneously, to give sufficiently full guidance to the agronomic cadres of the USSR for their day-to-day work.

Because of the huge territorial expanse of the Soviet Union, with the unique variety of its climate and because of the important role which agriculture plays in our land, with the continually growing demands of industry for plant raw materials and of the population of industrial centers for food products, the construction of a State plan for plant cultivation demands information as exact as possible about all cultivated crops and the most important useful wild plants in the USSR.

This book on the whole succeeds in presenting this information.

In view of the large size of this edition, the book is published in two volumes (in four parts), prepared for the press under the direction of Academician N. I. Vavilov, ^{who} is the responsible ^{le} ~~editor~~ editors. The Editorial Board consists of staff members of the Institute of Plant Cultivation -- Comrades N. V. Kovalev, V. V. Talanov, P. M. Zhukovskiy, N. N. Kuleshov, P. P. Zvorykin, M. A. Rozanovaya, K. A. Pangalo -- and the chief editor of the Leningrad Branch of the State Agricultural Publishing House, Comrade N. ^S ~~P~~. Pereverzev.

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The basic editorial work on the first volume was done by N. V. Kovalev and V. V. Talanov, with the assistance of N. N. Kuleshov and P. P. Zvorykin; in the second volume, by N. V. Kovalev and P. M. Zhukovskiy, with the assistance of M. A. Rozanov and K. A. Pangalo.

For publishing at the State Agricultural Publishing House, both volumes were edited by N. S. Pereverzev (authorized for print).

In the preparation of material for the first volume, Comrades V. P. Kuz'min, G. V. Kovalevskiy, and A. G. Grum-Grzhimaylo also helped, and the latter directed the technical preparation of all the graphic material, the majority of which was executed by the cartographer A. Ya Barskov.

The technical editing and supervision during publication of the entire edition was carried out by F. Ya. Shevchenko.

The binding, wrapping, and embossing of the title are the work of the artist M. M. Smirnova.

In working out the book over one hundred workers of the Institute of Plant Cultivation took part, and, naturally, owing to a certain haste in the work, one may find in it a number of defects, in the coordination of the various articles as well as in their individual contents. Many of these defects were noticed by the editors but could not be corrected in this edition for technical reasons.

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RESTRICTEDSPECIALIZATION OF AGRICULTURAL ZONES ACCORDING
TO CLIMATIC CONDITIONS

G. T. Selyaninov

GENERAL OBJECTIVES

As the basis of a socialist organization of agricultural production, after ^{the} ~~considering~~ ^{action of} matters of a social-political order one doubtless ought to put a more intensive utilization of natural resources of the land by a rational disposition of agricultural plants and cultivation methods, independent from plans of industrialization and considering natural-historic conditions.

All possible natural-historic conditions which are important for agriculture are made up of peculiarities of cultivated plants, conditions of climate, soil, and biological surroundings.

Noting that soil and biological surroundings are themselves produced by climate, the zones of which are doubtless determined by physical-geographic conditions, after considering the task of planning and characteristics of the plants themselves we should take up climate, and then soil.

However, considering climatic conditions is more difficult than considering soil conditions, for the influence of soil on yield is more evident than the influence of climate. The spacial distribution of soils is incomparably more exactly known than that of climate, so the basis for determining zones was always in the past soil, with the role of climate somewhat ^{obscure} ~~concealed~~. Yet, study of agricultural geography clearly reveals that the spatial distribution of crops is incomparably less dependent on soil than on climate, despite the fact that soil, it would seem, reflecting on itself the influence of climate, might have

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an effect on the plant combining its properties and the properties of the climate.

It is sufficient to point out that the northern and mountain boundaries of all crops are not so much determined by the soil as by the quantity of active heat for the growing season, and in several cases also by conditions of wintering. The physical properties of the soil have influenced the boundaries only in certain ways -- for example, sandy soils move the boundaries of crops towards the north. (For example, the map of the dissemination of wheat in the USSR drawn up by Makarov^y shows that the northern boundary of wheat extends considerably further north in the area[#] of the Upper Ustyug, where there is light soil.) The eastern boundaries of crops are also not very dependent on soil, but, aside from economic conditions, are determined by the degree of continentalness of the climate and, chiefly, by conditions of wintering. An example of this is winter wheat. Finally, the southern boundaries of crops are only slightly influenced by the character of the soil. This influence is disclosed most definitely in the southern and eastern boundary of agriculture, which is somewhat south of the northern boundary of the dark-brown chernozem, but this influence is rather indefinite; for one thing, it is not completely clear just what are the signs of "dark-brown" soil, and of soil in general, and what is the agronomic significance of these.

Unless one directs one's attention to the southern boundary of agriculture as a whole, the absence of a connection between the southern boundaries of crops and the character of the soil may be considered completely obvious. Thus, for example, the southern boundary of fiber linen does not coincide with the southern boundary of the podsol. Doubtless the boundary of fiber linen, apart from social-economic conditions,

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is determined in the east by the aridity of the climate and in the west by the amount of heat during the main period of growth. In both cases -- with a lack of moisture or a high temperature -- the yield and the quality of linen fiber drop. (A. Lebedev, "The Geographic Distribution of Linen-Producing Districts in the USSR," *Works in Applied Botany and Agriculture* XVIII, Volume 1, 1928.) Thus it is, for example, that in the United States of America the completely undeveloped cultivation of fiber linen is limited to insignificant plain lands in the extreme northeast (state of Michigan) and in the northwest (state of Oregon), where low temperatures combine with great amounts of humidity. This is also evident in other zones of fiber linen cultivation in the world. Linen crops are found in localities with a dry hot summer (Egypt, India), but this does not contradict this dependency which we have pointed out, since in subtropic countries linen is cultivated in the cold part of the year, which is provided with sufficient moisture.

It also beyond doubt that the southern boundary of potatoes, buckwheat, peas, cabbage, fruit-growing, and grapes is determined by, in addition to contemporary economic conditions, thermal conditions. But these conditions, in certain cases, act upon the plant not only directly but also indirectly -- for example, through fungus parasites, which in humid climatic conditions are excessively active. For this reason plants of temperate countries do not succeed in the humid subtropics, and grapes make no progress in humid tropical lands.

Moreover, it is essential to notice that the quality of agricultural products is far more determined by climate than by soil. The vitreousness of the wheat grain, the amount that the linen oil has dried out, the saccharinity of the beet and the grape are all clearly aspects of the climate. In certain conditions, the dependence of the quality of

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a product on the climate is really striking, as, for example, with Black-Sea tobacco or the Sochi plum, which owe their quality to the singular conjunction of definite temperature conditions with the small daily variability of these conditions, the high humidity with an abundance of direct sunlight, and, only lastly, to the soil. The high quality of the grapes of Abrau, Anapa, and the southern shore of the Crimea are also determined by the peculiarity of the climate of these places, although the character of the soil here also has a certain importance.

Finally, the boundaries for agricultural methods are organically linked to the climate. The boundary of the utilization of ~~bar~~ ^{bar} ~~Fallow~~ is wholly determined by the amount of moisture in the growing season. Methods of harvesting (the combine) (A. K. Ivanov), its drying, the consequent storage and reprocessing, methods of combatting pests, meliorative measures (drainage, irrigation), types of agricultural construction, the working routine -- all are closely linked to the climate.

It is clear that with such an organic link between agriculture and climate, the entire economic system ought to be built on a consideration of climatic peculiarities of the land, moreover with all climatic wealth maximally utilized, so that damage from meteorological phenomena should be at a minimum.

As the basis for building agricultural production, we doubtless ought to postulate above all the intensive utilization of thermal and hydrologic resources of the growing season. For each place we ought to grow only those crops which utilize all available heat and moisture resources and utilize them more efficiently.

It is clear that the resolution of this problem rests not only on the expedient selection of species of cultivated crops, but also of

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varieties, for according to data on agricultural ecology, different varieties of the same crop with different rates of growth are found under the same climatic conditions -- so they differ in productivity, following the terminology of Professor Atstsi (Ecologia Agraria, 1928).

Thus, from the point of view of climatic expediency, it is necessary above all to cultivate species and varieties of plants which grow through the entire growing season. It is a fact that at ~~the~~ present in the southern part of the USSR the most important grain crops are on the field during far from all the growing season, and an important part of the ^{area} ~~area~~ is utilized very extensively. Thus, in the southern Ukraine winter wheat is harvested in mid-July, and in the North Caucasus at the beginning of July, as a result of which there remains unutilized heat which is active on wheat (of 1,870 degrees) in the southern Ukraine and of 2,250 degrees in ^{the} Kuban -- in the first case 50 percent of the amount of heat during the growing season, in the second 60 percent. Even if winter crops are sown -- which means that the autumn heat is also utilized -- around 50 percent of all active heat is still lost.

Even ^{spring} ~~spring~~ grain (wheat, oats), ripening considerably earlier than winter grain, leaves a huge quantity of heat unutilized. How this unutilized heat is distributed over the expanses of the European part of the USSR may be seen from the following table.

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HEAT UNUTILIZED DURING AUTUMN

WINTER WHEAT

Station	Altitude (meters above sea level)	Latitude	Longitude	a-Date		Number of days between a and b	Unutilized degree of temperature over 10 degrees	Percent of un- utilized heat as regards the total amount of heat
				of yellow ripe- ing	of 10 degrees Centi- grade			
Perm'	163	58°01'	56°16'	2 Aug	12 Sept	41	510	29
Uspenskiy Agricultural School	242	56°38'	39°12'	7 Aug	14 Sept	38	484	26
Minsk	225	53°54'	27°33'	8 Aug	22 Sept	45	618	23
Shatilovo	242	53°00'	37°23'	7 Aug	20 Sept	44	619	29
Bezenchuk	47	52°59'	49°29'	20 Jul	24 Sept	66	1,134	45
Tambov	130	52°44'	41°28'	26 Jul	23 Sept	59	946	39
Novozybkov	170	52°32'	31°56'	27 Jul	25 Sept	60	899	40
Voronezh	122	51°40'	39°13'	21 Jul	27 Sept	68	1,114	44
Pogozhe	235	51°36'	37°16'	14 Jul	25 Sept	73	1,188	50
Bogoroditskoe	221	51°10'	37°21'	22 Jul	27 Sept	67	1,075	44
Khar'kov	116	50° 4'	36° 9'	9 Jul	1 Oct	84	1,426	54
Kamyshin	24	50° 5'	45°24'	11 Jul	4 Oct	85	1,629	57
Uman'	216	48°45'	30°13'	9 Jul	4 Oct	87	1,443	55
Migeya	90	48° 2'	30°57'	11 Jul	10 Oct	91	1,601	54
Rostov-on-the-Don	48	47°13'	39°43'	7 Jul	15 Oct	100	1,800	54
Odessa (ploughed field)	50	46°30'	30°40'	5 Jul	19 Oct	106	1,943	61
Obitochenskaya	60	46°44'	36°24'	3 Jul	13 Oct	102	1,825	61
Yeysk	21	46°40'	38°16'	3 Jul	19 Oct	108	2,096	61
Krasnodar	34	45° 2'	38°56'	1 Jul	27 Oct	118	2,293	63

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Table 2

HEAT UNUTILIZED DURING AUTUMN

<u>Station</u>	<u>Altitude</u> (meters above sea level)	<u>Latitude</u> <u>Longitude</u>	<u>OATS</u>		<u>Unutilized heat</u>		<u>Percent of un- utilized heat as regards the total amount of heat</u>
			<u>a-Date</u> of yellow ripen-	<u>ture</u> of 10 degrees Centi- grade	<u>Number-</u> of days between a and b	<u>degree of</u> temperature over 10 degrees	
Vologda	122	59°14'	39°53'	22 Aug 10 Sept	19	237	14
Novgorod	28	58°33'	31°14'	3 Sep 16 Sept	13	124	7
Perm'	163	58°01'	56°16'	6 Aug 12 Sept	37	470	26
Uskpen'skiy Agricultural							
School	242	56°38'	39°12'	17 Aug 14 Sept	28	326	18
Moscow	167	55°50'	37°33'	12 Aug 16 Sept	35	468	24
Kazan'	79	55°44'	49°10'	7 Aug 18 Sept	42	630	29
Beleev'skiy Agricultural							
School	273	53°55'	54°38'	6 Aug 16 Sept	41	572	28
Shatilovo	242	53°00'	37°23'	2 Aug 20 Sept	49	718	34
Khar'kov	116	50°04'	36°09'	15 Jul 1 Oct	78	1,303	49
Kamyshin	24	50°05'	45°24'	19 Jul 4 Oct	77	1,437	50
Stalingrad	42	48°42'	44°31'	16 Jul 9 Oct	85	1,630	49
Uman'	216	48°15'	30°13'	18 Jul 4 Oct	78	1,266	48
Ploti	143	47°57'	29°10'	29 Jul 12 Oct	75	1,215	41
Yeysk	21	46°40'	38°16'	7 Jul 19 Oct	104	2,001	58
Krasnodar	34	45°02'	38°56'	11 Jul 27 Oct	108	2,030	56

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Table 3

HEAT UNUTILIZED DURING AUTUMN

SUMMER WHEAT

<u>Station</u>	Altitude (meters above sea level)	b-Date of Tempera-		Unutilized degree of temperature between over a and b 10 degrees	Percent of un- utilized heat as regards the total amount
		a-Date of yellow ripen- Centi- grade	ture of 10 degrees		
Kirillov	122	59°52' 38°23'	14Aug 10Sept	27 320	20
Perm'	163	58°01' 56°16'	18Aug 12Sept	25 283	16
Savali	110	56°33' 50°36'	30Aug 16Sept	48 727	35
Belebeevskaya	273	53°55' 54°38'	10Aug 16Sept	37 501	24
Tomashev Kolok	104	53°14' 50°12'	21Jul 23Sept	64 1,056	43
Tambov	130	52°44' 41°28'	7Aug 23Sept	47 701	29
Bezenchuk	47	52°59' 49°29'	23Jul 24Sept	63 1,048	42
Voronezh	122	51°40' 39°13'	3Aug 27Sept	55 850	33
Balashov	153	51°33' 43°09'	30Jul 26Sept	58 940	36
Ural Agricultural School	34	51°15' 51°17'	24Jul 28Sept	66 1,154	42
Kamyshin	24	50°05' 45°24'	22Jul 4Oct	74 1,366	48
Stalingrad	42	48°42' 44°31'	20Jul 9Oct	81 1,532	46
Ploti	143	47°57' 29°10'	26Jul 12Oct	78 1,276	43
Rostov-on-the-Don	48	47°13' 39°43'	13Jul 15Oct	94 1,726	52
Obitochenskaya	60	46°44' 36°24'	15Jul 13Oct	90 1,555	52
Yeysk	21	46°40' 38°16'	12Jul 19Oct	99 1,883	55
Stavropol'	575	45°03' 41°59'	24Jul 8Oct	76 1,203	48

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Numbers designating soils on the map of the European USSR	Administrative Division Type of Soil	Leningrad Oblast	Karelia	Northern Kray, with Koms Oblast	Belorussia	Western Oblast
I ₁	Soils of the arid and marshy tundra . .	26,800	--	287,800	--	--
II ₁	Peaty-marshy soils.	--	--	--	--	--
III ₁	Peaty-podsolic and podsolic-gley soils.	--	--	--	--	--
III ₂	Podsolic soils, arpillaceous, arpillaceous-loamy, and stony- gravelly	68,100	12,500	317,600	17,600	65,500
III ₃	Podsols with predominately light arpillaceous-loamy and sandy-loamy varieties.	219,800	128,700	462,500	23,300	59,100
III ₄	Podsolic soils, arenaceous, primarily pine-forest soils.	15,800	2,100	38,900	84,600	29,000
VIII ₁	Brown forest soils of the Caucasus and the Crimea	--	--	--	--	--
VIII ₂	Krasnozemy.	--	--	--	--	--

the Crimea		--	--	--	--	--
VIII ₂	Krasnozemy.	--	--	--	--	--
VIII ₃	Mountain podsollic soils	--	--	--	--	--
IX ₁	Alluvial bottom lands of the northern zone	1,000	--	12,300	1,300	2,600
III ₅	Greatly degraded ("vt." podsollic) gray and brown argillaceous and argillaceous-loamy	--	--	--	--	9,300
III ₆	The same, arenaceous-loamy.	--	--	--	--	--
III ₅ + III ₆	Greatly degraded (gray forest) + the same, arenaceous-loamy	--	--	--	--	--
IV ₁	Degraded and leached chernozems	--	--	--	--	600
IV ₂	Degraded chernozems + the same, arenaceous- loamy.	--	--	--	--	--
IV ₁ + IV ₂	Degraded and leached chernozems + the same, arenaceous loamy.	--	--	--	--	--
IV ₃	Rich and potent chernozems.	--	--	--	--	400
IV ₄	Ordinary chernozems	--	--	--	--	--
IV ₅	Southern chernozems	--	--	--	--	--
IV ₆	Rich, ordinary, and southern chernozems, arenaceous loamy	--	--	--	--	--
IV ₇	Gray-sand chernozems.	--	--	--	--	--
IV ₈	Chernozems of the Sea of Azov Region.	--	--	--	--	--

IV ₅	Southern chernozems	--	--	--	--	--
IV ₆	Rich, ordinary, and southern chernozems, arenaceous loamy	--	--	--	--	--
IV ₇	Gray-sand chernozems	--	--	--	--	--
IV ₈	Chernozems of the Sea of Azov Region. .	--	--	--	--	--
IV ₉	North Caucasian chernozems	--	--	--	--	--
IV ₁₀	Carbonaceous chernozems on solid formations	--	--	--	--	--
III ₅ + III ₆ + IV ₁ +	Combination degraded soils + solontsy +					
IV ₂ + VII ₁ + VII ₅	solodi	--	--	--	--	--
IV ₄ + IV ₅ + IV ₆ +	Combination chernozems + solontsy +					
VII ₁ + VII ₅ + VII ₈	solodi	--	--	--	--	--
VII ₈	Saliferous chernozems	--	--	--	--	--
VIII ₄	Mountain chernozems	--	--	--	--	--
V ₁	Dark-chestnut argillaceous loamy. . . .	--	--	--	--	--
V ₂	Light-chestnut argillaceous loamy . . .	--	--	--	--	--
V ₃	Light-chestnut arenaceous loamy	--	--	--	--	--
V ₄	Chestnut soils of the Crimea and the Caucasus	--	--	--	--	--
VIII ₅	Chestnut and brown soils of mountain steppes	--	--	--	--	--
IX ₂	Alluvial saliferous soils of the steppe zone	--	--	--	--	--
VI ₁	Light brown argillaceous loamy	--	--	--	--	--

331,500	143,300	1,119,100	126,800	166,500
---------	---------	-----------	---------	---------

but they have not been studied in detail.

** In the area of mountainous chernozems is included Lake Sevan, the area of which is 1,400 square kilometers.

*** Relates to the chernozem zone.

Completed

AREAS OF SOILS BY DISTRICTS

EUROPEAN PART OF THE USSR

(in square kilometers)

Moscow Oblast	Ivanovo Oblast	Nizhegorod Kray	Uralskaya Oblast	The Ukraine	Central Black-Earth Oblast	Central Volga Kray	Tatar ASSR	Bashkir ASSR	Crimean ASSR	North-Cauca- sian ASSR
--	--	--	225,700	--	--	--	--	--	--	--
--	--	--	451,100	--	--	--	--	--	--	--
--	--	--	128,500	--	--	--	--	--	--	--
44,800	45,700	64,600	468,400	--	50	3,100	1,000	47,700	--	--
42,300	44,100	85,500	179,600	21,100	50	11,200	--	3,300	--	--
21,700	25,800	68,500	8,200	37,500	5,500	9,900	--	--	--	--
--	--	--	--	--	--	--	--	--	3,200	19,200
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	6,600

--	--	--	--	--	--	--	--	--	--	3,200	19,200
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	6,600
5,100	3,700	11,600	38,300	37,400	9,900	8,600	5,400	2,800	--	--	11,400
20,500	5,100	27,400	12,000	31,700	19,100	9,900	31,100	40,900	--	--	--
900	--	1,700	3,800	1,300	800	5,900	--	0,400	--	--	--
--	--	--	2,400	--	--	--	--	--	--	--	--
21,500	--	9,200	--	36,700	39,300	25,100	18,300	30,800	--	--	8,400
--	--	--	--	22,400	550	6,000	6,000	1,700	--	--	--
--	--	--	26,100	--	--	--	--	--	--	--	--
1,100	--	--	12,300	36,300	87,200	43,200	6,900	28,100	--	--	6,300
--	--	--	16,300	97,000	26,600	55,200	--	2,900	--	--	12,100
--	--	--	4,500	44,600	--	37,700	--	--	3,100	--	33,800
--	--	--	16,700	61,100	2,900	1,500	--	--	300	--	5,900
--	--	--	--	--	400	700	--	--	--	--	1,900

--	--	--	16,700	61,100	2,900	1,500	--	--	300	5,900
----	----	----	--------	--------	-------	-------	----	----	-----	-------

--	--	--	--	--	400	700	--	--	--	1,900
--	--	--	--	2,300	--	--	--	--	3,300	84,900
--	--	--	--	--	--	--	--	--	2,600	--
--	--	--	--	300	50	4,200	--	--	2,200	2,900
--	--	--	58,100	--	--	--	--	--	--	--
--	--	--	41,200	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	3,000
--	--	--	--	--	--	--	--	--	--	6,500
--	--	--	--	--	--	7,500	--	--	--	25,900
--	--	--	--	--	--	--	--	--	--	15,400
--	--	--	--	5,100	--	4,100	--	--	--	0,900
--	--	--	--	13,000	--	--	--	--	2,800	8,100
--	--	--	--	--	--	--	--	--	7,200	--
--	--	--	14,000	--	--	1,500	--	--	--	3,800

--	--	--	--	--	--	--	--	--	7,200	--
--	--	--	14,000	--	--	1,500	--	--	--	3,800
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	1,100
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	5,500
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	8,100
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	200	6,500
--	--	--	--	--	--	--	--	--	--	9,900
--	--	--	2,000	--	--	--	--	--	--	1,700
--	--	--	--	4,200	--	--	--	--	400	3,800
157,900	124,400	268,500	1,709,800	452,000	192,400	235,300	68,600	158,600	25,300	292,900

This chart follows the soil maps of the Soil Institute imeni Dokuchaev of the Academy of Sciences.

Table 1

Lower Volga Kray	Dagestan ASSR	Trans-Caucasian SFSR	Total	By Zones
--	--	--	540,300	Tundra
--	--	--	451,100	
--	--	--	128,500	
--	--	2,800	1,159,450	Podsol zone 3,638,000*
200	--	3,200	1,283,950	
100	--	--	347,600	
--	200	40,000	62,600	
--	--	5,800	5,800	
--	--	6,100	12,700	
--	--	1,300	186,300	

100	--	--	347,600	Podsi 3,638,000*
--	200	40,000	62,600	
--	--	5,800	5,800	
--	--	6,100	12,700	
25,700	4,900	4,300	186,300	
200	--	--	207,100	
700	--	--	15,500	
--	--	--	2,400	
4,300	--	1,300	195,500	
--	--	--	36,650	
--	--	--	26,100	
26,200	3,200	--	251,200	
19,200	--	900	230,200	
46,200	--	6,600	176,500	
6,300	--	--	94,700	zone (1,467,300)

3,600	--	--	6,600	Chernozem	1,489,500
800	--	--	90,600		
--	--	--	2,600		
2,000	--	--	11,650		
--	--	--	58,100		
--	--	--	41,200		
800	--	--	3,800		
--	--	10,400**	16,900		
23,500	4,300	7,700	68,900		
36,400	1,000	13,700	66,500		
3,100	--	--	13,200	Chestnut-soil zone	(211,400)
--	0,800	--	24,700		
--	3,800	4,900	15,900		
1,700	0,600	--	22,200***		

--	--	12,700	12,700
40,300	3,100	--	44,500
--	1,500	23,200	24,700

--	3,800	4,900	15,900	Chestnut	
1,700	0,600	--	22,200***		
--	--	12,700	12,700	Serozem zone	
40,300	3,100	--	44,500		
--	1,500	23,200	24,700		
6,200	--	--	6,200		
57,500	900	--	63,900		185,700
1,600	4,300	--	5,900		
7,500	--	--	7,500		
--	4,100	1,900	14,100		
--	0,400	5,800	6,200		
--	10,500	500	17,700		
--	2,300	32,500	44,700	Mountain areas	66,900
--	100	700	4,500		
14,700	8,200	500	31,800	Desert lands	31,800
328,800	54,200	185,500	6,141,400		6,141,400

Measuring of areas was done by the geographers Smirnitzkiy and Ptitsyn, with verification and computations by M. A. Antonov, under the direction of L. I. Prasolov.

1931.

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Numerical Order	Republics, Krays, and Oblasts	Curly Flax		Long-Fiber Flax		Hemp	
		Absolute	Percent	Absolute	Percent	Absolute	Percent
1	USSR	726.5	0.53	2,338.6	1.70	923.6	0.6
2	Ukrainian SSR	134.0	0.46	25.0	0.09	181.0	0.6
3	Belorussian SSR	-----	-----	242.5	6.32	31.5	0.8
4	ZSFSR	9.7	0.41	-----	-----	0.8	0.0
	Including:						
	Azerbaijdzhan SSR	2.1	0.19	-----	-----	0.8	0.0
	Georgian SSR	1.8	0.19	-----	-----	-----	-----
	Armenian SSR	5.8	1.40	-----	-----	-----	-----
5	Uzbek SSR	20.0	0.78	-----	-----	-----	-----
6	Turkmen SSR	-----	-----	-----	-----	-----	-----
7	Tadzhik SSR	34.0	3.96	-----	-----	-----	-----
8	RSFSR	528.8	0.54	2,071.1	2.11	710.3	0.7
	Including:						
1	Northern (Severnny) Kray	-----	-----	67.1	5.97	1.1	0.0
2	Karelian ASSR	-----	-----	0.7	0.41	-----	-----
3	Leningrad Oblast	-----	-----	256.9	12.42	0.4	0.0
4	Western Oblast	-----	-----	574.5	11.74	82.4	1.6
5	Moscow Oblast	-----	-----	204.5	3.66	38.2	0.6
6	Ivanovo Industrial Oblast	-----	-----	199.9	8.73	-----	-----
7	Nizhegorod Kray	40.6	0.65	348.0	5.61	35.9	0.5
8	Uralskaya Oblast	64.9	0.91	237.0	3.32	30.3	0.4
9	Bashkir ASSR	35.3	1.00	-----	-----	25.2	0.7
10	Tatar ASSR	53.7	1.73	-----	-----	23.2	0.7
11	Central-Volga Kray	43.0	0.43	-----	-----	114.0	1.1
12	Central Black Earth Oblast (Ts Ch O)	31.6	0.29	-----	-----	196.9	1.7
13	Lower Volga Kray	28.9	0.31	-----	-----	5.2	0.0
14	Central Caucasian Kray	54.0	0.44	-----	-----	10.0	0.0
15	Dagestan ASSR	-----	-----	-----	-----	-----	-----
16	Crimean ASSR	23.5	2.48	-----	-----	-----	-----
17	Kazakh ASSR	40.0	0.67	-----	-----	18.0	0.3
18	Kara-Kalpak Autonomous Oblast	-----	-----	-----	-----	-----	-----
19	Kirgiz ASSR	10.5	1.04	-----	-----	2.5	0.2
20	Western Siberian Kray	80.3	0.99	144.0	1.78	101.8	1.2
21	Eastern Siberian Kray	6.9	0.34	16.2	0.80	22.2	1.0
22	Far Eastern Kray	15.6	1.61	22.3	2.29	3.0	0.3
23	Yakutsk ASSR	-----	-----	-----	-----	-----	-----

Hemp		Sunflower Seed		Soybean		Sugar Beet		Tobacco (Nicotiana Tabacum)		Makhorka Tobacco (Nicotiana Rustica)		Abs
Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Abs
923.6	0.67	4,599.6	3.35	461.4	0.34	1,494.8	1.09	74.9	0.05	89.1	0.06	2
181.0	0.62	1,040.0	3.54	191.0	0.65	1,195.0	4.07	----	----	45.0	0.15	
31.5	0.84	-----	----	-----	----	-----	----	-----	----	2.0	0.05	
0.8	0.04	6.3	0.24	88.3	3.57	1.8	0.08	23.7	0.97	-----	----	
0.8	0.09	1.3	0.12	6.0	0.56	-----	----	0.7	0.07	-----	----	
-----	----	4.6	0.47	82.1	8.45	1.2	0.12	20.7	2.13	-----	----	
-----	----	0.4	0.10	0.2	0.05	0.6	0.14	2.3	0.55	-----	----	
-----	----	-----	----	-----	----	-----	----	1.2	0.05	-----	----	1
-----	----	-----	----	-----	----	-----	----	-----	----	-----	----	
-----	----	-----	----	0.2	0.02	-----	----	0.5	0.06	-----	----	
710.3	0.72	3,553.3	3.63	181.9	0.19	298.0	0.30	49.5	0.06	42.1	0.04	
1.1	0.09	-----	----	-----	----	-----	----	-----	----	-----	----	
-----	----	-----	----	-----	----	-----	----	-----	----	-----	----	
0.4	0.02	-----	----	-----	----	-----	----	-----	----	-----	----	
82.4	1.68	-----	----	-----	----	5.3	0.10	1.0	0.01	-----	----	
38.2	0.69	-----	----	-----	----	8.4	0.15	-----	----	5.5	0.10	
-----	----	-----	----	-----	----	-----	----	-----	----	0.3	0.01	
35.9	0.58	-----	----	-----	----	-----	----	-----	----	-----	----	
30.3	0.43	36.5	0.52	-----	----	-----	----	-----	----	1.0	0.01	
25.2	0.71	52.5	1.49	-----	----	-----	----	-----	----	-----	----	
23.2	0.74	7.9	0.25	-----	----	-----	----	-----	----	-----	----	
114.0	1.15	521.0	5.27	-----	----	-----	----	-----	----	2.3	0.02	
196.9	1.79	593.7	5.39	7.0	0.06	260.4	2.36	0.9	0.01	17.8	0.16	
5.2	0.06	665.5	7.25	5.1	0.06	1.0	0.01	3.8	0.04	10.1	0.11	
10.0	0.08	1,274.0	10.27	78.0	0.63	19.0	0.15	26.0	0.21	-----	----	
-----	----	-----	----	1.4	0.42	-----	----	-----	----	-----	----	
-----	----	2.8	0.29	0.3	0.03	-----	----	7.3	0.76	-----	----	
18.0	0.30	278.0	4.66	9.0	0.15	-----	----	3.0	0.05	5.0	0.02	
-----	----	-----	----	-----	----	-----	----	-----	----	-----	----	
2.5	0.25	9.9	0.97	1.1	0.11	3.0	0.30	1.3	0.13	0.1	0.01	
101.8	1.26	93.6	1.16	-----	----	-----	----	3.6	0.04	-----	----	
22.2	1.09	2.3	0.11	-----	----	-----	----	0.9	0.05	-----	----	
3.0	0.31	15.6	1.61	80.0	8.22	0.9	0.09	1.2	0.12	-----	----	
-----	----	-----	----	-----	----	-----	----	-----	----	-----	----	

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t	Cotton		Mustard		Castor Plant		Peanut		Kenaf		Abutilon		Ab
	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	
	2,358.7	1.72	333.9	0.24	160.9	0.12	4.3	0.00	56.6	0.04	15.7	0.01	
	161.0	0.55	22.0	0.07	18.0	0.06	1.0	0.00	3.0	0.01	3.0	0.01	
	-----	-----	0.6	0.02	-----	-----	-----	-----	-----	-----	-----	-----	
	258.2	10.48	-----	-----	1.0	00.4 [3/5]	2.1	0.08	11.8	0.49	1.4	0.04	
	209.7	19.50	-----	-----	1.0	0.09	0.4	0.04	6.5	0.60	1.1	0.10	
	21.8	2.25	-----	-----	-----	-----	1.6	0.17	4.6	0.48	0.3	0.03	
	26.7	6.43	-----	-----	-----	-----	0.1	0.02	0.7	0.17	-----	-----	
	1,034.0	40.38	5.5	0.21	0.4	0.02	0.5	0.02	8.0	0.31	-----	-----	
	196.0	47.35	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
	114.0	13.29	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
4	595.5	0.61	305.8	0.31	141.5	0.14	0.7	0.00	33.8	0.03	11.3	0.01	
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
	-----	-----	1.0	0.00	-----	-----	-----	-----	-----	-----	-----	-----	
0	-----	-----	2.4	0.04	-----	-----	-----	-----	-----	-----	-----	-----	
01	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
	-----	-----	1.9	0.03	-----	-----	-----	-----	-----	-----	-----	-----	
01	-----	-----	1.5	0.02	-----	-----	-----	-----	-----	-----	-----	-----	
	-----	-----	2.0	0.05	-----	-----	-----	-----	-----	-----	-----	-----	
	-----	-----	8.7	0.28	-----	-----	-----	-----	-----	-----	-----	-----	
02	-----	-----	29.1	0.29	-----	-----	-----	-----	-----	-----	3.0	0.03	
16	-----	-----	2.7	0.02	-----	-----	-----	-----	-----	-----	-----	-----	
11	1.1	0.01	161.5	1.76	3.2	0.03	0.2	0.00	0.5	0.01	-----	-----	
	220.0	1.78	32.5	0.26	134.2	1.08	0.3	0.00	11.3	0.09	6.5	0.05	
	27.9	8.36	-----	-----	0.3	0.09	-----	-----	3.4	1.02	-----	-----	
	33.9	5.57	-----	-----	0.6	0.06	-----	-----	-----	-----	-----	-----	
02	135.0	2.26	47.7	0.80	3.1	0.05	0.2	0.00	8.7	0.15	1.8	0.03	
	72.2	56.19	-----	-----	-----	-----	-----	-----	5.0	3.89	-----	-----	
01	105.4	10.40	15.7	1.55	0.1	0.01	-----	-----	4.9	0.48	-----	-----	
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
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	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	

Percent	Abutilon		Medicinal and Volatile-Oil Plants ¹		Miscellaneous Oil Bearing Plants ²		Miscellaneous Technical Crops ³		Total Technical and Oil Bearing Plants	
	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent
0.04	15.7	0.01	60.7	0.04	353.98	0.26	22.4	0.02	14,075.7	10.24
0.01	3.0	0.01	6.0	0.02	60.0	0.21	11.0	0.04	3,096.0	10.55
									276.6	7.23
0.49	1.4	0.04			2.9	0.12	0.4	0.01	408.4	16.57
0.60	1.1	0.10			2.4	0.22			232.0	21.58
0.48	0.3	0.03			0.5	0.05	0.3	0.03	139.5	14.37
0.17							0.1	0.02	36.9	8.88
0.31			0.5	0.02	54.6	2.13			1,124.7	43.92
					14.0	3.38			210.0	50.73
					15.3	1.79			164.0	19.12
0.03	11.3	0.01	54.2	0.06	207.18	0.21	11.0	0.01	8,796.0	8.97
									68.2	6.06
									0.7	1.41
									257.3	12.44
									663.8	13.56
									259.0	4.64
							7.2	0.32	207.4	9.06
									426.4	6.87
					4.3	0.06			375.5	5.27
					2.1	0.06			117.1	3.31
					7.8	0.25			101.3	3.25
	3.0	0.03	1.7	0.02	7.7	0.08			721.8	7.29
			42.4	0.38	10.5	0.09			1,163.9	10.55
0.01			2.6	0.03	0.6	0.01			889.3	9.69
0.09	6.5	0.05	6.5	0.05	5.85	0.05	3.0	0.02	1,881.2	15.17
1.02					6.8	2.04			39.8	11.93
			1.0	0.12	2.7	0.28	0.2	0.02	72.3	7.61
0.15	1.8	0.03			64.6	1.09	0.6	0.01	614.7	10.30
3.89					1.5	1.17			78.7	61.25
0.48					23.93	2.35			178.4	17.60
					66.2	0.82			489.5	6.05
					1.9	0.09			50.4	2.48
					0.7	0.07			139.3	14.32

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Numerical Order	Republics, Krays, and Oblasts	Wheat		Rye		Oats		Barley	
		Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent
1	USSR	25,722.4	18.70	570.0	0.41	17,501.8	12.73	6,514.0	4.74
2	Ukrainian SSR	2,316.0	7.89	-----	-----	1,876.0	6.39	2,950.0	10.06
3	Belorussian SSR	40.0	1.04	15.0	0.39	606.4	15.82	261.7	6.84
4	ZSFSR	184.6	7.50	0.8	0.03	5.1	0.20	168.2	6.82
	Including: Azerbaydzhan SSR	12.6	1.17	-----	-----	1.6	0.15	18.6	1.73
	Georgian SSR	48.4	4.98	-----	-----	1.6	0.17	68.2	7.02
	Armenian SSR	123.6	29.75	0.8	0.19	1.9	0.46	81.4	19.59
5	Uzbek SSR	690.0	26.95	-----	-----	-----	-----	120.0	4.69
6	Turkmen SSR	61.0	14.74	-----	-----	-----	-----	4.0	0.97
7	Tadzhik SSR	290.0	33.80	-----	-----	-----	-----	132.0	15.32
8	RSFSR	22,140.8	22.58	554.2	0.57	15,014.3	15.31	2,878.1	2.94
1	Including: Northern Severnyy Kray	22.4	2.05	-----	-----	318.3	28.34	150.1	13.37
2	Karelian ASSR	-----	-----	-----	-----	13.0	26.16	4.0	8.05
3	Leningrad Oblast	13.0	0.63	13.3	0.64	468.6	22.66	121.4	5.87
4	Western Oblast	45.9	0.94	17.2	0.35	842.0	17.20	138.1	2.82
5	Moscow Oblast	2.6	0.05	2.0	0.04	1,176.0	21.05	40.6	0.78
6	Ivanovo Industrial Oblast	31.1	1.36	8.8	0.39	508.6	22.22	46.5	2.03
7	Nizhegorod Kray	70.4	1.13	30.0	0.48	1,825.8	29.40	202.2	3.26
8	Uralskaya Oblast	2,585.3	36.23	-----	-----	1,876.5	26.30	287.3	4.03
9	Bashkir ASSR	995.5	27.04	-----	-----	749.0	21.19	21.8	0.6
10	Tatar ASSR	180.1	5.79	-----	-----	668.6	21.49	12.7	0.41
11	Central-Volga Kray	3,053.5	30.86	-----	-----	1,228.7	12.42	37.0	0.37
12	Central Black Earth Oblast	443.4	4.02	-----	-----	1,753.3	15.89	166.8	1.51
13	Lower Volga Kray	3,745.1	40.80	-----	-----	586.1	6.39	181.9	1.98
14	Central-Caucasian Kray	2,127.0	17.15	-----	-----	396.0	3.19	773.0	6.23
15	Dagestan ASSR	12.8	3.83	-----	-----	7.6	2.28	30.8	9.23
16	Crimean ASSR	-----	-----	-----	-----	72.4	7.60	149.9	15.79
17	Kazakh ASSR	3,117.8	52.27	20.0	0.34	404.0	6.77	147.0	2.46
18	Kara-Kalpak Autonomous Oblast	2.2	1.71	-----	-----	-----	-----	1.0	0.78
19	Kirgiz ASSR	445.0	43.90	-----	-----	60.8	6.0	116.0	11.44
20	Western Siberian Kray	4,303.5	53.25	76.3	0.94	1,353.4	16.74	125.5	1.60
21	Eastern Siberian Kray	647.0	31.80	348.3	17.12	437.3	21.50	86.6	4.26
22	Far Eastern Kray	326.9	33.59	18.3	1.88	262.1	26.93	21.7	2.23
23	Yakutsk ASSR	10.3	20.28	20.0	39.37	6.2	12.21	13.2	25.98

RESTRICTED

SPRING GRAIN SOWING AREA

Oats		Barley		Corn		Sorghum		Buckwheat		Proso Millet		Rice	
Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent
7,501.8	12.73	6,514.0	4.74	3,966.1	2.88	3.1	0.00	2,199.8	1.60	5,402.5	3.93	136.3	0.10
1,876.0	6.39	2,950.0	10.06	1,562.0	5.32	---	---	642.0	2.19	620.0	2.11	---	---
606.4	15.82	261.7	6.84	---	---	---	---	170.2	4.44	30.0	0.78	---	---
5.1	0.20	188.2	6.82	364.5	14.78	0.1	0.00	---	---	10.6	0.45	23.7	0.97
1.6	0.15	18.6	1.73	3.4	0.32	---	---	---	---	5.5	0.51	23.2	2.15
1.6	0.17	68.2	7.02	360.8	37.14	0.1	0.01	---	---	4.5	0.46	0.5	0.05
1.9	0.46	81.4	19.59	0.3	0.07	---	---	---	---	0.6	0.14	---	---
---	---	120.0	4.69	50.0	1.95	---	---	---	---	5.0	0.19	60.0	2.34
---	---	4.0	0.97	10.0	2.42	---	---	---	---	---	---	1.5	0.46
---	---	132.0	15.32	3.0	0.35	---	---	---	---	---	---	8.0	0.94
5,014.3	15.31	2,878.1	2.94	1,976.6	2.02	---	0.00	1,387.6	1.41	4,736.9	4.83	43.1	0.05
318.3	28.34	150.1	13.37	---	---	---	---	---	---	---	---	---	---
13.0	26.16	4.0	8.05	---	---	---	---	---	---	---	---	---	---
468.6	22.66	121.4	5.87	---	---	---	---	2.5	0.12	---	---	---	---
842.0	17.20	138.1	2.82	---	---	---	---	178.8	3.57	12.1	0.24	---	---
1,176.0	21.05	40.6	0.78	---	---	---	---	172.2	3.08	136.1	2.44	---	---
508.6	22.22	46.5	2.03	---	---	---	---	13.4	0.58	---	---	---	---
1,825.8	29.40	202.2	3.26	---	---	---	---	48.5	0.78	39.7	0.64	---	---
1,876.5	26.30	287.3	4.03	---	---	---	---	50.7	1.13	130.7	1.83	---	---
749.0	21.19	21.8	0.6	1.6	0.05	---	---	118.2	3.34	281.7	7.97	---	---
668.6	21.49	12.7	0.41	---	---	---	---	116.5	3.75	88.2	2.83	---	---
1,228.7	12.42	37.0	0.37	63.0	0.63	---	---	100.0	1.01	814.0	8.22	---	---
1,753.3	15.89	166.8	1.51	23.2	0.21	---	---	303.1	2.75	986.8	8.95	---	---
586.1	6.39	181.9	1.98	176.1	1.92	---	---	20.9	0.23	613.0	6.68	---	---
396.0	3.19	773.0	6.23	1,483.0	11.96	3.0	0.03	---	---	329.8	2.66	0.3	0.00
7.6	2.28	30.8	9.23	44.7	13.40	---	---	---	---	16.8	5.03	1.5	0.45
72.4	7.60	149.9	15.79	52.2	5.50	---	---	---	---	1.2	0.13	---	---
404.0	6.77	147.0	2.46	93.0	1.56	---	---	---	---	732.0	12.27	21.0	0.35
---	---	1.0	0.78	5.6	4.36	---	---	---	---	6.0	4.67	3.0	2.33
60.8	6.0	116.0	11.44	23.6	2.33	---	---	---	---	30.8	3.04	1.9	0.19
1,353.4	16.74	125.5	1.60	4.7	0.05	---	---	104.5	1.29	486.9	6.02	---	---
437.3	21.50	86.6	4.26	---	---	---	---	56.3	2.77	18.8	0.92	---	---
262.1	26.93	21.7	2.23	5.9	0.61	---	---	76.0	7.81	12.3	1.26	15.4	1.69
6.2	12.21	13.2	25.98	---	---	---	---	---	---	---	---	---	---

RESTRICTED

Wheat	Proso Millet		Rice		Speltz		Total Summer Grains		Total Leguminous Crops		Vetch for Seed	
	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute
1.60	5,402.5	3.93	136.3	0.10	298.9	0.22	62,315.0	45.31	2,407.1	1.75	1,117.3	0.81
2.19	620.0	2.11	-----	-----	-----	-----	9,966.0	33.96	496.0	1.69	320.0	1.09
4.44	30.0	0.78	-----	-----	-----	-----	1,123.3	29.31	64.0	1.67	20.0	0.52
-----	10.6	0.45	23.7	0.97	35.7	1.46	793.3	32.21	18.2	0.73	0.8	0.04
-----	5.5	0.51	23.2	2.15	4.2	0.39	69.1	6.42	11.3	1.02	-----	-----
-----	4.5	0.46	0.5	0.05	7.7	0.79	491.8	50.62	5.7	0.59	-----	-----
-----	0.6	0.14	-----	-----	23.8	5.73	232.4	55.93	1.2	0.29	0.8	0.19
-----	5.0	0.19	60.0	2.34	-----	-----	925.0	36.12	15.0	0.59	-----	-----
-----	-----	-----	1.5	0.46	-----	-----	76.5	18.59	5.0	1.21	-----	-----
-----	-----	-----	8.0	0.94	-----	-----	433.0	50.47	-----	-----	-----	-----
1.41	4,736.9	4.83	43.1	0.05	263.2	0.27	48,997.9	49.98	1,808.9	1.85	776.5	0.79
-----	-----	-----	-----	-----	-----	-----	490.8	43.76	20.3	1.78	-----	-----
-----	-----	-----	-----	-----	-----	-----	17.0	34.21	1.0	2.01	-----	-----
0.12	-----	-----	-----	-----	-----	-----	618.8	29.92	52.2	2.52	4.0	0.20
3.57	12.1	0.24	-----	-----	-----	-----	1,230.1	25.12	74.8	1.53	60.1	1.22
3.08	136.1	2.44	-----	-----	-----	-----	1,532.5	27.44	138.8	2.48	140.3	2.51
0.58	-----	-----	-----	-----	-----	-----	608.4	26.58	32.3	1.41	68.9	3.01
0.78	39.7	0.64	-----	-----	19.5	0.31	2,236.1	36.00	235.7	3.80	20.0	0.32
1.12	130.7	1.83	-----	-----	10.0	0.14	4,970.5	69.66	127.1	1.78	99.8	1.40
3.34	281.7	7.97	-----	-----	78.8	2.23	2,206.6	62.44	49.2	1.39	1.0	0.03
3.75	88.2	2.83	-----	-----	139.9	4.50	1,206.0	38.77	205.0	6.59	51.5	1.66
1.01	814.0	8.22	-----	-----	15.0	0.15	5,311.2	53.66	270.0	2.73	71.0	0.72
2.75	986.8	8.95	-----	-----	-----	-----	3,676.6	33.33	309.6	2.81	254.9	2.31
0.23	613.0	6.68	-----	-----	-----	-----	5,323.1	58.00	181.0	1.97	-----	-----
-----	329.8	2.66	0.3	0.00	-----	-----	5,112.1	41.22	37.0	0.30	5.0	0.04
-----	16.8	5.03	1.5	0.45	-----	-----	114.2	34.22	7.5	2.25	-----	-----
-----	1.2	0.13	-----	-----	-----	-----	275.7	29.04	2.5	0.26	-----	-----
-----	732.0	12.27	21.0	0.35	-----	-----	4,534.8	76.02	6.0	0.10	-----	-----
-----	6.0	4.67	3.0	2.33	-----	-----	17.8	13.85	1.0	0.78	-----	-----
-----	30.8	3.04	1.9	0.19	-----	-----	678.1	66.90	1.0	0.09	-----	-----
1.29	486.9	6.02	-----	-----	-----	-----	6,454.8	79.89	50.5	0.62	-----	-----
2.77	18.8	0.92	-----	-----	-----	-----	1,594.3	78.37	5.8	0.28	-----	-----
7.81	12.3	1.26	15.4	1.59	-----	-----	738.6	75.90	0.6	0.06	-----	-----
-----	-----	-----	-----	-----	-----	-----	49.7	97.84	-----	-----	-----	-----

RESTRICTED

RESTRICTEDAREAS OF SOILS, BY DISTRICTS

ASIATIC USSR

in square kilometers

Number on soil map of the Asiatic USSR	Administrative Divisions		Siberian Kray	Yakutsk ASSR	Far-Eastern Kray	Buryato-Mongolian ASSR
	Soil Types					
1	Arid tundra, argillaceous-stony		550,700	658,300	547,900	--
2	Marshy tundra		48,400	--	--	--
3	Forest-and-tundra, with marshy and podsolic soils		213,000	518,400	14,900	--
4	Peaty-marshy soils of higher mossy marshes		301,900	--	--	--
6	Peaty-gleyey soils of little potency. .		--	2,900	9,600	--
7	Podsolc soils of little potency on the northern forest boundary		753,800	1,488,300	--	--
8	Weakly podsolc argillaceous and argillaceous loamy		1,184,600	630,800	394,000	287,500
9	Strongly podsolc soils, and argilla- ceous and argillaceous-loamy podsols		389,300	--	747,000	--

Table 2

Turkmen ASSR	Uzbek ASSR	Kirgiz ASSR	Total	By Zones
--	--	--	1,756,900	Tundra
--	--	--	48,400	
--	--	--	746,300	
--	--	--	301,900	
--	--	--	12,500	
--	--	--	2,242,100	
--	--	--	2,496,900	
--	--	--	1,136,300	

Table 2

Kazak ASSR	Turkmen ASSR	Uzbek ASSR	Kirgiz ASSR	Total	By Zones
--	--	--	--	1,756,900	Tundra 2,551,600
--	--	--	--	48,400	
--	--	--	--	746,300	
--	--	--	--	301,900	
--	--	--	--	12,500	
--	--	--	--	2,242,100	
--	--	--	--	2,496,900	
--	--	--	--	1,136,300	

10	Arenaceous soils in various degrees					
	podsollic	63,800	42,600	7,600	--	--
11	Sands of the northern region, chiefly					
	under pines	29,100	--	--	4,100	5,500
12	Podsollic-gleyey and meadow-marsh soils					
	of the Far East ("verniki").	--	--	18,600	--	--
36	Podsollic soils and solontsy, in the Yakutsk					
	Oblast	--	351,100	--	--	--
40	Marshy solonchak soils of low seashores					
	("marshi")	2,100	4,700	--	--	--
49	Peaty-podsollic and peaty-marshy soils,					
	often rocky	117,100	256,200	433,700	36,300	--
48	Dark-colored podsolis, semi-marshy, not					
	infrequently rocky	121,900	--	--	--	22,500
13	Dark-gray, secondarily podsollic	146,900	--	--	14,500	10,200
13,13 31 II	The same, with podsollic soils and					
	solodi, in Western Siberia	41,400	--	--	--	--
14/21/31	Podsollic soils with dark-colored					
	chernozem-like soils, solodi, and					
	with patches of solontsy	--	--	--	--	35,900

--	--	--	--	--	114,000	Podsol zone	
4,100	5,500	--	--	--	38,700		(7,706,600)
--	--	--	--	--	18,600		7,802,300
--	--	--	--	--	351,100		(together with bottom lands)
--	--	--	--	--	6,800		
36,300	--	--	--	--	843,300		
--	22,500	--	--	--	144,400		
14,500	10,200	--	--	--	171,600		
--	--	--	--	--	41,400		
--	35,900	--	--	--	35,900		

15	Degraded and leached chernozems	48,000	--	--	12,900	
17	Rich argillaceous and argillaceous- loamy chernozems	41,200	--	--	--	
18	Ordinary argillaceous and argillaceous- loamy chernozems	55,600	--	--	--	1
18/14	The same, with podsollic soils in the west, and with solodi	14,400	--	--	--	22
29	Solonet z soils of the black-earth zone.	--	--	--	--	7
29/14	The same, with podsollic soils and solodi	28,200	--	--	--	38
18/14/31	Ordinary chernozems with podsollic soils solodi, and patches of solontsy . .	39,200	--	--	--	
18/14/52	Ordinary chernozems, argillaceous and argillaceous-loamy, with podsollic soils and solodi, rocky-gravelly . .	--	--	--	--	12
19	Southern chernozems, argillaceous and argillaceous-loamy	12,500	--	--	1,800	27
19/14	The same, with podsollic soils and solodi	--	--	--	--	18

12,900	--	--	--	--	60,900	
--	--	--	--	--	41,200	
--	1,000	--	--	--	56,600	
--	22,500	--	--	--	36,900	
--	7,600	--	--	--	7,600	
--	38,900	--	--	--	67,100	
--	--	--	--	--	39,200	
--	12,300	--	--	--	12,300	Chernozem zone (1,020,200) 924,500
1,800	27,100	--	--	--	41,400	(not including bottom lands)
--	18,400	--	--	--	18,400	

19/14/31	The same, with podsollic soils, solodi, and patches of solontsy.	20,600	--	--	--
19/14/32	The same, with podsollic soils, solodi, and solonchaki	16,500	--	--	--
19/14/52	The same, with podsollic soils and solodi, stony-gravelly	--	--	--	--
19/52	Southern chernozems, argillaceous and argillaceous-loamy, stony stony- rubbly	--	--	--	--
20	Argillaceous chernozems	--	--	--	--
20/14	The same, with podsollic soils and solodi	--	--	--	--
37	Meadow, marsh, and alluvial soils of river bottom lands of the north- central belt	22,000	17,300	42,500	1,000
39	Marshy-meadow and marshy-podsolic soils, on the zaymishcha of Western Siberia former chernozems salted	6,800	--	--	--

--	10,200	--	--	--	30,800	
--	--	--	--	--	16,500	
--	4,500	--	--	--	4,500	
--	12,300	--	--	--	12,300	
--	27,400	--	--	--	27,400	
--	21,900	--	--	--	21,900 ¹	¹ Related to the zone of podsol
1,000	12,900	--	--	--	95,700	
--	--	--	--	--	6,800	

9/14	The same, with podsollic soils and solodi	55,700	--	--	--	
45	Chernozems of the mountain steppes and mountain saliniferous soils, often stony	3,700	--	--	--	67
22	Dark-chestnut soils	4,200	--	--	5,500	301
22/14/31	The same, with podsollic soils, solodi and patches of solontsy	19,500	--	--	--	8
22/31	The same, with patches of solontsy . .	4,800	--	--	--	
22/52	The same, gravelly-rocky	--	--	--	--	162
23	Light-chestnut soils	--	--	--	--	97
23/31	The same, with patches of solontsy . .	--	--	--	--	116
23/32	The same, with solonchaki	--	--	--	--	5
23/32/31	The same, with solonchaki and spots of solontsy	--	--	--	--	8
23/52	The same, gravelly-rocky	--	--	--	--	205
23/52/31	The same, with patches saliferous and stony-rocky	--	--	--	--	2
24	Chestnut arenaceous and arenaceous- loamy (and brown)	12,800	--	--	--	74

9/14	The same, with podsollic soils and solodi	55,700	--	--	--	
45	Chernozems of the mountain steppes and mountain saliniferous soils, often stony	3,700	--	--	--	67
22	Dark-chestnut soils	4,200	--	--	5,500	301
22/14/31	The same, with podsollic soils, solodi and patches of solontsy	19,500	--	--	--	8
22/31	The same, with patches of solontsy . .	4,800	--	--	--	
22/52	The same, gravelly-rocky	--	--	--	--	162
23	Light-chestnut soils	--	--	--	--	97
23/31	The same, with patches of solontsy . .	--	--	--	--	116
23/32	The same, with solonchaki	--	--	--	--	5
23/32/31	The same, with solonchaki and spots of solontsy	--	--	--	--	8
23/52	The same, gravelly-rocky	--	--	--	--	205
23/52/31	The same, with patches saliferous and stony-rocky	--	--	--	--	2
24	Chestnut arenaceous and arenaceous- loamy (and brown)	12,800	--	--	--	74

--	--	--	--	--	55,700	
--	67,600	--	5,100	41,700	118,100	
5,500	301,100	--	--	--	310,800	
--	8,200	--	--	--	27,700	
--	--	--	--	--	4,800	
--	162,300	--	--	--	162,300	
--	97,600	--	--	--	97,600	
--	116,300	--	--	--	116,300	
--	5,100	--	--	--	5,100	
--	8,200	--	--	--	8,200	
--	205,800	--	--	--	205,800	1,458,200
--	2,000	--	--	--	2,000	
--	74,400	--	--	--	87,200	

Chestnut-soil zone

24/21	The same, with dark chernozem-like and saliniferous soils	--	--	--	--
24/21/31	The same, with patches of solontsy and solodi	--	--	--	--
30	Complexes of solontsy, saliferous soils, and solonchaki	8,200	--	--	--
30/28	The same, with sands	--	--	--	--
44	Chestnut mountain solonchak soils, often rocky	2,400	--	--	--
25	Typical serozemy	--	--	--	--
25/32	The same, with solonchaki	2,000	--	--	--
25/52	The same, gravelly-rocky.	--	--	--	--
26	Light serozems	--	--	--	--
26/52	The same, gravelly-rocky	--	--	--	--
27	Arenaceous serozems	--	--	--	--
27/28	The same, with sands	--	--	--	--
27/52	The same, gravelly-rocky	--	--	--	--
32	Solonchaki	--	--	--	--
32/28	The same, with sands	--	--	--	--

--	142,300	--	--	--	142,300	
--	56,100	--	--	--	56,100	
--	128,600	--	--	--	136,800	
--	5,500	--	--	--	5,500	
--	29,700	--	4,100	53,500	89,700	
--	49,400	19,500	5,300	11,400	85,600	
--	--	--	--	--	2,000	
--	6,800	--	--	--	6,800	
--	8,200	20,700	11,500	--	40,400	
--	8,000	--	21,400	--	29,400	
--	34,400	33,800	3,300	2,200	73,700	
--	7,200	--	--	--	7,200	
--	3,100	--	--	--	3,100	
--	44,600	15,400	800	--	60,800	
--	3,200	--	--	--	3,200	

Serozem zone

1,043,700

33	Serozems, saliferous and gypsiferous, generally rocky	--	--	--	--
33/28	The same, with sands	--	--	--	--
33/31	The same, with patches of solontsy . .	--	--	--	--
34	Oozy salted and dense soils (takyry) .	--	--	--	--
34/28	The same, with sands	--	--	--	--
34/32	The same, with solonchaki	--	--	--	--
41	Salted alluvia and meadow soils on bottom lands of southern rivers (tugai)	--	--	--	--
41/27	The same, with arenaceous serozemy . .	--	--	--	--
42	Meadow carbonaceous and salted soils of Turkestan	--	--	--	--
46	Dark-colored soils of mountain subalpine meadows and steppes . . .	--	--	--	--
47	Mountain-meadow soils of the alpine zone	23,800	--	--	--
43	Serozemy, chestnut soils, chernozems, and mountain saliniferous soils, for the most part rocky, in the mountain				

--	--	318,100	50,100	25,700	2,800	396,700
--	--	--	53,200	--	--	53,200
--	--	26,600	--	--	--	26,600
--	--	54,000	45,600	34,700	--	134,300
--	--	13,700	--	--	--	13,700
--	--	16,400	--	--	--	16,400
--	--	40,700	1,200	4,500	--	46,400
--	--	3,500	--	--	--	3,500
--	--	17,400	6,100	13,900	3,300	40,700
--	--	--	--	--	39,500	39,500
--	--	9,800	--	24,000	26,700	84,300

	sections of Tadzhikistan and					
	Uzbekistan	--	--	--	--	
35	Serozemy, saliferous and gypsiferous,					
	rocky-gravelly, of the Pamirs . . .	--	--	--	--	
50	Weakly podsolic, rocky soils with					
	patches of peaty-marshy soils, amid					
	cliffs and alluvial deposits					
	("gol'tsy")	11,100	52,700	222,600	--	
51	Glaciers, perpetual snows, rocky					
	heights	--	--	--	--	
28	Sands in the arid steppe and wasteland					
	region	--	--	700	--	475,
	Lakes	7,400	--	--	25,500	95,
	Total by regions	4,424,600	4,023,300	2,439,100	389,100	2,938,

This chart follows the soil maps of the Soil Institute imeni Dokuchaev of the Academy of Sciences. Measuring of area by the geographers Smirnitzkiy and Ptitsyn, with verification and computations by I. S. Sey, under the direction of I

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--	--	3,100	125,600	8,500	137,200	Mountain areas	582,300
--	--	--	33,700	--	33,700		
--	--	--	--	--	286,400		
--	--	--	--	1,200	1,200		
--	475,700	242,500	21,400	2,300	742,600		
25,500	95,900	--	2,500	4,900	136,200	Lakes	136,200
389,100	2,938,600	491,200	337,500	198,000	15,241,400		15,241,400

ences. Measuring of areas was done
 , under the direction of L. I. Prasolov.

--	--	3,100	125,600	8,500	137,200	Mountain areas	582,300
--	--	--	33,700	--	33,700		
--	--	--	--	--	286,400		
--	--	--	--	1,200	1,200		
--	475,700	242,500	21,400	2,300	742,600		
25,500	95,900	--	2,500	4,900	136,200	Lakes	136,200
389,100	2,938,600	491,200	337,500	198,000	15,241,400		15,241,400

ences. Measuring of areas was done
 , under the direction of L. I. Prasolov.

RESTRICTED**PRELIMINARY TOTALS OF THE WINTER GRAIN SOWING**

(The present table had to be compiled at the articles in the editions were obtained at an different places.)

Numerical Order	Republics, Krays, and Oblasts	SOWED					
		Wheat		Rye		Barley	
		Absolute	Percent	Absolute	Percent	Absolute	Percent
1.	USSR	12,052.0	8.77	28,073.0	20.41	358.0	0.26
2.	Ukrainian SSR	5,631.0	19.19	5,252.0	17.89	6.0	0.02
3.	Belorussian SSR	32.0	0.84	1,418.0	37.01	---	---
4.	ZSFSR	920.0	37.37	---	---	235.0	9.54
	Including: Azerbaydzhan SSR	530.0	49.30	---	---	211.0	19.63
	Georgian SSR	269.0	27.71	---	---	21.0	2.16
	Armenian SSR	121.0	29.12	---	---	3.0	0.72
5.	Uzbek SSR	248.0	9.69	---	---	16.0	0.62
6.	Turkmen SSR	73.0	17.63	---	---	7.0	1.69
7.	Tadzhik SSR	208.0	24.24	---	---	14.0	1.63
8.	RSFSR	4,940.0	5.04	21,403.0	21.83	80.0	0.08
1.	Including: Northern Kray	---	---	390.0	34.76	---	---
2.	Karelian ASSR	---	---	20.0	40.24	---	---
3.	Leningrad Oblast	16.0	0.77	570.0	27.56	---	---
4.	Western Oblast	10.0	0.20	1,723.0	35.20	---	1.7
5.	Moscow Oblast	35.0	0.63	1,804.0	32.29	---	1.8
6.	Ivanovo Industrial Oblast	39.0	1.70	709.0	30.98	---	7
7.	Nizhegorod Kray	7.0	0.11	2,561.0	41.24	---	2,5
8.	Ural'skaya Oblast	1.0	0.01	1,142.0	16.01	---	1.1
9.	Bashkir ASSR	---	---	930.0	26.31	---	9
10.	Tatar ASSR	---	---	1,298.0	41.73	---	1,2
11.	Central-Volga Kray	3.0	0.03	2,668.0	26.96	---	2,6
12.	Central Black Earth Oblast (TsCho)	400.0	3.63	3,568.0	32.35	---	3,9
13.	Lower-Volga Kray	90.0	0.98	2,132.0	23.23	3.0	0.03 2,2
14.	Central-Caucasian Kray	3,380.0	27.25	771.0	6.22	63.0	0.51 4,2
15.	Dagestan ASSR	130.0	38.95	6.0	1.80	11.0	3.30 1
16.	Crimean ASSR	530.0	55.81	13.0	1.37	3.0	0.32 5
17.	Kazakh ASSR	204.0	3.42	119.0	1.99	---	---
18.	Kara-Kalpak Autonomous Oblast	10.0	7.78	---	---	---	---
19.	Kirgiz ASSR	85.0	8.39	---	---	---	---
20.	Western Siberian Kray	---	---	694.0	7.91	---	---
21.	Eastern Siberian Kray	---	---	248.0	12.19	---	---
22.	Far Eastern Kray	---	---	37.0	3.80	---	---
23.	Yakutsk ASSR	---	---	---	---	---	---

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WINTER GRAIN SOWING FOR 1930 AND THE

SPRING GRAIN SOWING FOR 1931, FROM DATA OF THE NKZ USSR

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ed at the moment this article
med at an earlier time.

was at the press, while figures on sowing areas for other
Therefore data on sowing areas may differ somewhat in

WINTER GRAIN SOWING AREA

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Key	Total		Wheat		Rye		Barley		Total		
	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent
0.26	40,483.0	29.44	11,932.7	8.68	27,478.7	19.98	351.4	0.26	39,762.8	28.92	
0.02	10,889.0	37.10	5,578.0	19.01	5,205.0	17.73	6.0	0.02	10,789.0	36.76	
---	1,450.0	37.85	32.0	0.83	1,356.0	35.40	----	----	1,388.0	36.23	
9.54	1,155.0	46.91	901.8	36.64	----	----	228.4	9.26	1,130.2	45.90	
19.63	741.0	68.93	520.6	48.43	----	----	205.4	19.10	726.0	67.53	
2.16	290.0	29.87	263.3	27.09	----	----	20.0	2.05	283.2	29.14	
0.72	124.0	29.84	118.0	28.40	----	----	3.0	0.72	121.0	29.12	
0.62	264.0	10.31	248.0	9.69	----	----	16.0	0.62	264.0	10.31	
1.69	80.0	19.32	73.0	17.63	----	----	7.0	1.69	80.0	19.32	
1.63	222.0	25.87	208.0	24.24	----	----	14.0	1.63	222.0	25.87	
0.08	26.423.0	26.95	4,891.0	4.99	20,917.7	21.33	80.0	0.08	25,889.6	26.40	
----	390.0	34.76	----	----	382.5	34.05	----	----	382.5	34.05	
----	20.0	40.24	----	----	19.7	36.64	----	----	19.7	36.64	
----	586.0	28.33	16.0	0.77	570.0	27.56	----	----	586.0	28.33	
----	1,733.0	35.10	9.8	0.00	1,673.8	34.79	----	----	1,683.6	34.39	
----	1,839.0	32.92	34.8	0.62	1,799.0	32.21	----	----	1,833.8	32.83	
----	748.0	32.68	39.0	1.70	700.9	30.63	----	----	739.9	32.33	
----	2,568.0	41.35	7.0	0.11	2,556.7	41.17	----	----	2,563.7	41.28	
----	1,143.0	16.02	1.0	0.01	1,054.6	14.78	----	----	1,055.6	14.79	
----	930.0	26.31	----	----	925.8	26.20	----	----	925.8	26.20	
----	1,298.0	41.73	----	----	1,265.4	40.68	----	----	1,265.4	40.68	
----	2,671.0	26.99	3.0	0.03	2,588.1	26.15	----	----	2,591.1	26.18	
----	3,968.0	35.98	392.6	3.56	3,462.1	31.39	----	----	3,854.7	34.95	
0.03	2,225.0	24.24	83.4	0.91	2,094.9	22.83	3.0	0.03	2,181.3	23.77	
0.51	4,214.0	33.98	3,346.3	26.97	771.0	6.22	63.0	0.51	4,180.3	33.70	
3.30	147.0	44.05	130.0	38.95	6.0	1.80	11.0	3.30	147.0	44.05	
0.32	546.0	57.50	530.0	55.81	13.0	1.37	3.0	0.32	546.0	57.50	
----	323.0	5.41	204.0	3.42	109.7	1.84	----	----	313.7	5.26	
----	10.0	7.78	10.0	7.78	----	----	----	----	10.0	7.78	
----	85.0	8.39	85.0	8.39	----	----	----	----	85.0	8.39	
----	694.0	7.91	----	----	639.5	7.91	----	----	639.5	7.91	
----	248.0	12.19	----	----	248.0	22.19	----	----	248.0	12.19	
----	37.0	3.80	----	----	37.0	3.80	----	----	37.0	3.80	
----	----	----	----	----	----	----	----	----	----	----	

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while figures on sowing areas for other
sowing areas may differ somewhat in

HARVESTED

Rye		Barley		Total	
Absolute	Percent	Absolute	Percent	Absolute	Percent
27,478.7	19.98	351.4	0.26	39,762.8	28.92
5,205.0	17.73	6.0	0.02	10,789.0	36.76
1,356.0	35.40	----	----	1,388.0	36.23
----	----	228.4	9.26	1,130.2	45.90
----	----	205.4	19.10	726.0	67.53
----	----	20.0	2.05	283.2	29.14
----	----	3.0	0.72	121.0	29.12
----	----	16.0	0.62	264.0	10.31
----	----	7.0	1.69	80.0	19.32
----	----	14.0	1.63	222.0	25.87
20,917.7	21.33	80.0	0.08	25,889.6	26.40
382.5	34.05	----	----	382.5	34.05
19.7	36.64	----	----	19.7	36.64
570.0	27.56	----	----	586.0	28.33
1,673.8	34.19	----	----	1,683.6	34.39
1,799.0	32.21	----	----	1,833.8	32.83
700.9	30.63	----	----	739.9	32.33
2,556.7	41.17	----	----	2,563.7	41.28
1,054.6	14.78	----	----	1,055.6	14.79
925.8	26.20	----	----	925.8	26.20
1,265.4	40.68	----	----	1,265.4	40.68
2,588.1	26.15	----	----	2,591.1	26.18
3,462.1	31.39	----	----	3,854.7	34.95
2,094.9	22.83	3.0	0.03	2,181.3	23.77
771.0	6.22	63.0	0.51	4,180.3	33.70
6.0	1.80	11.0	3.30	147.0	44.05
13.0	1.37	3.0	0.32	546.0	57.50
109.7	1.84	----	----	313.7	5.26
----	----	----	----	10.0	7.78
----	----	----	----	85.0	8.39
639.5	7.91	----	----	639.5	7.91
248.0	22.19	----	----	248.0	12.19
37.0	3.80	----	----	37.0	3.80
----	----	----	----	----	----

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TUBER-ROOT AND CUCURBIT PLANTS

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Numerical Order	Republics, Krays and Oblasts	Potatoes		Tuber-Root Plants		Cucurbits	
		Absolute	Percent	Absolute	Percent	Absolute	Percent
1	USSR	6,103.9	4.44	589.9	0.43	957.8	0.70
2	Ukrainian SSR	1,178.0	4.01	187.0	0.64	279.0	0.95
3	Belorussian SSR	574.3	14.98	30.5	0.81	---	---
4	ZSFSR	37.6	1.54	2.4	0.08	8.1	0.33
Including:							
	Azerbaydzhan SSR	9.9	0.93	0.8	0.07	5.8	0.54
	Georgian SSR	16.6	1.71	0.8	0.08	2.2	0.23
	Armenian SSR	11.1	2.67	0.8	0.19	0.1	0.02
5	Uzbek SSR	---	---	---	---	32.0	1.25
6	Turkmen SSR	---	---	---	---	6.0	1.45
7	Tadzhik SSR	---	---	---	---	3.0	0.35
8	RSFSR	4,314.0	4.40	370.0	0.38	629.7	0.64
Including:							
1	Northern (Severnny) Kray	53.3	4.72	7.7	0.71	---	---
2	Karelian SSR	3.0	6.03	0.5	1.01	---	---
3	Leningrad Oblast	156.4	7.56	9.5	0.46	---	---
4	Western Oblast	493.5	10.09	13.6	0.28	---	---
5	Moscow Oblast	670.3	12.00	41.9	0.75	---	---
6	Ivanovo Industrial Oblast	206.4	9.02	7.4	0.32	---	---
7	Nizhegorod Kray	364.7	5.87	7.5	0.12	---	---
8	Ural'skaya Oblast	173.6	2.44	25.0	0.35	5.2	0.07
9	Bashkir ASSR	118.3	3.34	8.9	0.25	2.0	0.06
10	Tatar ASSR	176.4	5.67	6.8	0.22	---	---
11	Central-Volga Kray	417.0	4.21	33.0	0.33	63.0	0.64
12	Central Black Earth Oblast (TsChO)	871.6	7.91	80.0	0.73	26.7	0.24
13	Lower Volga Kray	143.4	1.56	30.7	0.33	139.7	1.52
14	Central Caucasian Kray	145.0	1.17	53.0	0.43	278.0	2.24
15	Dagestan ASSR	5.8	1.74	0.3	0.09	9.4	2.82
16	Crimean ASSR	2.8	0.29	1.5	0.16	7.9	0.83
17	Kazakh ASSR	43.2	0.73	12.0	0.20	71.0	1.19
18	Kara-Kalpak Autonomous Oblast	0.5	0.39	---	---	---	---
19	Kirgiz ASSR	7.3	0.72	0.5	0.05	4.1	0.40
20	Western Siberian Kray	172.9	2.14	24.2	0.30	22.7	0.28
21	Eastern Siberian Kray	53.0	2.60	5.4	0.27	---	---
22	Far Eastern Kray	34.8	3.58	0.6	0.06	---	---
23	Yakutsk ASSR	0.8	1.57	---	---	---	---

Numerical Order	Republics, Krays and Oblasts	Potatoes		Tuber-Root Plants		Cucurbits	
		Absolute	Percent	Absolute	Percent	Absolute	Percent
1	USSR	6,103.9	4.44	589.9	0.43	957.8	0.70
2	Ukrainian SSR	1,178.0	4.01	187.0	0.64	279.0	0.95
3	Belorussian SSR	574.3	14.98	30.5	0.81	---	---
4	ZSFSR	37.6	1.54	2.4	0.08	8.1	0.33
	Including:						
	Azerbaijdzhan SSR	9.9	0.93	0.8	0.07	5.8	0.54
	Georgian SSR	16.6	1.71	0.8	0.08	2.2	0.23
	Armenian SSR	11.1	2.67	0.8	0.19	0.1	0.02
5	Uzbek SSR	---	---	---	---	32.0	1.25
6	Turkmen SSR	---	---	---	---	6.0	1.45
7	Tadzhik SSR	---	---	---	---	3.0	0.35
8	RSFSR	4,314.0	4.40	370.0	0.38	629.7	0.64
	Including:						
1	Northern (Severnny) Kray	53.3	4.72	7.7	0.71	---	---
2	Karelian SSR	3.0	6.03	0.5	1.01	---	---
3	Leningrad Oblast	156.4	7.56	9.5	0.46	---	---
4	Western Oblast	493.5	10.09	13.6	0.28	---	---
5	Moscow Oblast	670.3	12.00	41.9	0.75	---	---
6	Ivanovo Industrial Oblast	206.4	9.02	7.4	0.32	---	---
7	Nizhegorod Kray	364.7	5.87	7.5	0.12	---	---
8	Ural'skaya Oblast	173.6	2.44	25.0	0.35	5.2	0.07
9	Bashkir ASSR	118.3	3.34	8.9	0.25	2.0	0.06
10	Tatar ASSR	176.4	5.67	6.8	0.22	---	---
11	Central-Volga Kray	417.0	4.21	33.0	0.33	63.0	0.64
12	Central Black Earth Oblast (TsChO)	871.6	7.91	80.0	0.73	26.7	0.24
13	Lower Volga Kray	143.4	1.56	30.7	0.33	139.7	1.52
14	Central Caucasian Kray	145.0	1.17	53.0	0.43	278.0	2.24
15	Dagestan ASSR	5.8	1.74	0.3	0.09	9.4	2.82
16	Crimean ASSR	2.8	0.29	1.5	0.16	7.9	0.83
17	Kazakh ASSR	43.2	0.73	12.0	0.20	71.0	1.19
18	Kara-Kalpak Autonomous Oblast	0.5	0.39	---	---	---	---
19	Kirgiz ASSR	7.3	0.72	0.5	0.05	4.1	0.40
20	Western Siberian Kray	172.9	2.14	24.2	0.30	22.7	0.28
21	Eastern Siberian Kray	53.0	2.60	5.4	0.27	---	---
22	Far Eastern Kray	34.8	3.58	0.6	0.06	---	---
23	Yakutsk ASSR	0.8	1.57	---	---	---	---

¹Including onion and garlic, cucumber, tomato, cabbage, table root plants, and other garden crops.

Tree-Root Plants		Cucurbits		Garden Crops ¹		Annual Grasses		Perennial ² Grasses, Covered		Grasses, Uncovered		At
Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	
89.9	0.43	957.8	0.70	2,030.9	1.47	3,197.3	2.33	692.3	0.50	735.5	0.53	
87.0	0.64	279.0	0.95	756.0	2.58	1,048.0	3.57	---	---	150.0	0.51	
30.5	0.81	---	---	67.0	1.75	83.6	2.19	81.6	2.14	4.5	0.11	
2.4	0.08	8.1	0.33	28.1	1.14	16.1	0.65	---	---	8.3	0.33	
0.8	0.07	5.8	0.54	9.7	0.90	0.6	0.06	---	---	5.7	0.55	
0.8	0.08	2.2	0.23	15.6	1.61	13.4	1.38	---	---	---	---	
0.8	0.19	0.1	0.02	2.8	0.67	2.1	0.51	---	---	2.6	0.63	
---	---	32.0	1.25	20.0	0.78	---	---	---	---	180.0	7.03	
---	---	6.0	1.45	4.5	0.97	---	---	---	---	32.0	7.73	
---	---	3.0	0.35	8.1	0.93	---	---	---	---	28.0	3.26	
70.0	0.38	629.7	0.64	1,147.2	1.17	2,049.6	2.09	610.7	0.62	332.7	0.34	
7.7	0.71	---	---	10.6	0.98	25.6	2.32	23.5	2.14	---	---	
0.5	1.01	---	---	0.8	1.61	4.0	8.05	---	---	---	---	
9.5	0.46	---	---	50.1	2.42	58.6	2.83	83.4	4.03	1.1	0.05	
13.6	0.28	---	---	69.1	1.41	150.2	3.06	81.3	1.66	---	---	
41.9	0.75	---	---	115.5	2.07	364.6	6.53	95.3	1.71	13.0	0.23	
7.4	0.32	---	---	28.4	1.24	62.6	2.74	55.7	2.43	4.7	0.20	
7.5	0.12	---	---	46.9	0.76	105.1	1.69	81.9	1.32	1.9	0.03	
25.0	0.35	5.2	0.07	63.3	0.88	49.3	0.69	30.1	0.42	8.1	0.12	
8.9	0.25	2.0	0.06	17.9	0.51	20.9	0.59	31.3	0.89	15.9	0.45	
6.8	0.22	---	---	17.4	0.56	61.3	1.97	10.6	0.34	1.6	0.05	
33.0	0.33	63.0	0.64	83.0	0.84	163.0	1.65	---	---	32.0	0.32	
80.0	0.73	26.7	0.24	202.5	1.84	421.7	3.82	57.2	0.52	13.0	0.12	
30.7	0.33	139.7	1.52	55.1	0.60	108.5	1.18	2.5	0.03	13.8	0.15	
53.0	0.43	278.0	2.24	211.0	1.70	235.0	1.89	13.1	0.10	65.5	0.53	
0.3	0.09	9.4	2.82	6.5	1.95	3.0	0.90	---	---	---	---	
1.5	0.16	7.9	0.83	11.8	1.24	4.1	0.43	---	---	7.6	0.80	
12.0	0.20	71.0	1.19	49.6	0.84	83.0	1.39	---	---	135.0	2.26	
---	---	---	---	4.0	3.11	---	---	---	---	16.0	12.45	
0.5	0.05	4.1	0.40	6.3	0.62	14.9	1.47	---	---	---	---	
24.2	0.30	22.7	0.28	62.4	0.77	70.4	0.87	38.7	0.48	1.2	0.01	
5.4	0.27	---	---	16.7	0.82	39.6	1.95	6.1	0.30	2.3	0.11	
0.6	0.06	---	---	18.3	1.88	3.9	0.40	---	---	---	---	
---	---	---	---	---	---	0.3	0.59	---	---	---	---	

and other garden crops.

²Perennial grasses "covered" are not included in the columns

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Perennial ² Grasses, Covered Acreage Percent	Grasses, Uncovered		Harvested Last Year		Total Grass		Silage		Entire Sow- ing area sub- ject to Harvest		
	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	Absolute	Percent	
92.3	0.50	735.5	0.53	3,470.3	2.52	7,403.1	5.38	751.9	0.55	137,515.4	100
--	---	150.0	0.51	870.0	2.96	2,068.0	7.04	215.0	0.73	29,350.0	100
81.6	2.14	4.5	0.11	188.0	4.91	276.1	7.21	11.3	0.29	3,831.1	100
--	---	8.3	0.33	5.9	0.24	30.3	1.22	4.7	0.20	2,462.2	100
--	---	5.7	0.55	3.4	0.32	9.7	0.93	0.9	0.08	1,075.2	100
--	---	---	---	---	---	13.4	1.38	2.6	0.27	971.5	100
--	---	2.6	0.63	2.5	0.60	7.2	1.73	1.2	0.29	415.5	100
--	---	180.0	7.03	---	---	180.0	7.03	---	---	2,560.7	100
--	---	32.0	7.73	---	---	32.0	7.73	---	---	414.0	100
--	---	28.0	3.26	---	---	28.0	3.26	---	---	858.1	100
10.7	0.62	332.7	0.34	2,406.4	2.46	4,788.7	4.89	520.9	0.53	98,039.3	100
23.5	2.14	---	---	59.6	5.26	85.2	7.58	3.9	0.36	1,122.5	100
--	---	---	---	3.0	6.03	7.0	14.08	---	---	49.7	100
3.4	4.03	1.1	0.05	267.4	12.93	327.1	15.81	7.1	0.34	2,068.5	100
81.3	1.66	---	---	450.8	9.22	601.0	12.28	6.3	0.12	4,895.9	100
95.3	1.71	13.0	0.23	456.0	8.16	833.6	14.92	19.8	0.36	5,585.5	100
55.7	2.43	4.7	0.20	316.9	13.85	384.2	16.79	5.5	0.24	2,288.8	100
81.9	1.32	1.9	0.03	195.0	3.14	302.0	4.86	7.7	0.12	6,210.7	100
30.1	0.42	8.1	0.12	155.0	2.18	212.4	2.99	27.1	0.38	7,135.1	100
31.3	0.89	15.9	0.45	45.2	1.28	82.0	2.32	5.4	0.15	3,534.3	100
10.6	0.34	1.6	0.05	13.6	0.44	76.5	2.46	4.3	0.14	3,110.6	100
--	---	32.0	0.32	66.0	0.67	261.0	2.64	75.0	0.76	9,897.1	100
57.2	0.52	13.0	0.12	108.2	0.98	542.9	4.92	45.8	0.41	11,029.2	100
2.5	0.03	13.8	0.15	43.9	0.48	166.2	1.81	68.8	0.75	9,178.6	100
3.1	0.10	65.5	0.53	47.0	0.38	347.5	2.80	153.0	1.23	12,403.1	100
--	---	---	---	---	---	3.0	0.90	0.2	0.05	333.7	100
--	---	7.6	0.80	---	---	11.7	1.23	17.4	1.84	949.7	100
--	---	135.0	2.26	75.0	1.26	293.0	4.91	27.0	0.45	5,965.0	100
--	---	16.0	12.45	0.5	0.39	16.5	12.84	---	---	128.5	100
--	---	---	---	38.1	3.76	53.0	5.23	---	---	1,013.7	100
8.7	0.48	1.2	0.01	48.6	0.61	120.2	1.49	44.3	0.54	8,081.0	100
6.1	0.30	2.3	0.11	16.6	0.82	58.5	2.88	2.3	0.11	2,034.4	100
--	---	---	---	---	---	3.9	0.40	---	---	973.1	100
--	---	---	---	---	---	0.3	0.59	---	---	50.8	100

ed" are not included in the columns "Total grass" and "Total sowing area."

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Table 3

SOIL AREAS BY ZONES AND THEIR DISTRIBUTION BY TYPES OF FIELDS

Zones and chief types of soil	Areas in square kilometers			Chief types of fields and their area
	European USSR	Asiatic USSR	Total	
1. Tundra and forest-and-tundra . .	540,000	2,551,700	3,091,900	Reindeer pasture land, marshes, sparse woodlands, shoals, rocks, etc.
2. Podsollic and marshy. (and mountain forest soils of the Caucasus and Tyan'-Shan')	3,638,000	7,802,300	11,440,300	Forests. 8,900,000 Swamps 1,500,000 Meadows. 400,000 Ploughed land. 400,000 Various unstudied unsuitable places. 240,300
3. Chernozems (+ gray forest soils, saliferous soils, meadow soils, solontsy, solody, etc.)	1,489,500	924,500	2,414,000	Forests (for the most part deciduous). 300,000 Meadows and zaymishcha . . . 100,000 Saliferous steppes 320,000 Mountain steppes 130,000 Ploughed land. 1,500,000 Various unstudied expanses: waters, shore lands, etc. 64,000
4. Chestnut soils (+ solontsy, saliferous and meadow soils, etc.)	189,200	1,458,200	1,647,400	Pasture land on rocky steppes 370,000 Unstudied areas. 112,400 Pasture land on saliferous

Ploughed land. 1,500,000

Various unstudied expenses:

waters, shore lands, etc. 64,000

4. Chestnut soils	189,200	1,458,200	1,647,400	Pasture land on rocky steppes	370,000
(+ solontsy, saliferous and				Unstudied areas.	112,400
meadow soils, etc.)				Pasture land on saliferous	
				steppes	460,000
				Pasture land on argillaceous-	
				loamy and arenaceous-loamy	
				chestnut soils.	500,000
				Mountain steppes	105,000
				Ploughed land.	100,000
5. Serozemy	217,500	1,786,300	2,003,800	Saliniferous and rocky	
(+ solonchaki, sands of desert				wastelands (winter and	
lands, meadow, saliferous, and				fall pasture land	825,000
alluvial soils, tugai, etc.)				Takyry (thickened-saliferous	
				soils).	110,000
				Tugai (alluvial soils,	
				marshy and salted). . . .	52,000
				Sands (bare or overgrown). .	655,000
				Haloxene forests (according	
				to data of the forest	
				service	120,000

Haloxene forests (according
to data of the forest
service 120,000

6. Soils of high-mountain regions .	66,900	582,300	649,200	Meadows (tugai, plavni, etc.)	54,000
(mountain-meadow, mountain tundra,				Ploughed land, in all around	
high mountain steppe, and waste-				50,000, and arid steppes,	
land soils + perpetual snows,				in all around 137,800,	
glaciers, and rocks)				total	167,800
				Mountain meadows of the	
				alpine and subalpine zone	186,000
				High-mountain steppes of the	
				western Tyan'-Shan'	
				Mountains	137,000
				Mountain wastelands of the	
				Pamir Mountains	34,000
				Mountain tundra (the	
				Siberian gol'tsy)	286,000
				Snows, glaciers, and moun-	
				tain heights.	6,200
Total	6,141,400	15,105,200	21,246,600		
		+ lakes 136,200	+ lakes 136,200		
			21,382,800		

Total	6,141,400	15,105,200	21,246,600
		+ lakes 136,200	+ lakes 136,200
			21,382,800

Notes:

The general area of ploughed lands, according to the Institute of Soil Management, is 2,050,000 square kilometers. Its zonal distribution is not exactly determined. Meadow bottom land soils are in part counted in with bottom lands of the forest zone.

Soils of subtropic forests -- krasnozemy and others -- are counted in with mountain forest soils of the Caucasus.

Asiatic sections of these oblasts are counted in with the European part here: Koma, Ural, the Central-Volga Kray, Bashkiria, and also all of Transcaucasia.

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Republics and Regions of Gosplan	1913 ¹	1925 ²	1926 ²	1927 ³		
				Of These		
				Total	Collective Farms	State Farms
USSR	116,675.0	103,790.7	109,727.6	112,936.0	752.3	1,227.5
Ukrainian SSR.	--	23,099.1	24,016.9	25,261.4	264.6	606.2
BSSR	--	3,026.3	3,154.0	3,364.9	22.0	37.6
ZSFSR.	--	2,047.7	2,097.0	2,093.9	1.5	2.4
Uzbek SSR.	--	1,869.4	1,911.6	1,584.5	6.2	5.3
Tadzhik SSR.	--			467.5	--	--
Turkmen SSR.	--	248.8	280.6	295.7	1.0	2.3
RSFSR ⁵	--	73,499.4	78,267.5	79,868.1	457.0	573.7
Included: Northern Kray	--	--	--	1,024.9	1.9	2.2
Karelian ASSR.	--	--	--	59.7	--	--
Leningrad Oblast	--	--	--	1,856.1	7.2	16.6
Western Oblast	--	--	--	4,321.9	13.1	37.6
Moscow Oblast.	--	--	--	4,848.5	15.5	46.6
Ivanovo Industrial Oblast.		Data		2,068.3	4.0	9.7
Nizhniy-Novgorod Kray.		within		5,818.9	11.7	11.9

19283			19293			19304		
ese		Of	these		Of These			Of These
State	Total	Collective	State	Total	Collective	State	Total	Collective
Farms		Farms	Farms		Farms	Farms		Farms
1,227.5	114,528.2	1,382.9	1,409.2	119,589.5	4,169.3	1,819.0	127,766.73	38,340.20
606.2	24,929.3	305.7	647.8	25,543.8	928.7	719.2	28,362.9	11,252.2
37.6	3,398.0	25.2	41.1	3,491.7	40.7	39.5	3,021.61	488.42
2.4	2,137.6	12.5	5.8	2,232.3	43.0	8.0	2,472.02	362.0
5.3	1,743.4	20.1	6.9	1,892.1	68.0	21.3	2,595.96	802.50
--	545.3	--	--	603.7	6.7	0.3	895.5	132.90
2.3	326.5	1.3	2.3	351.7	11.8	2.6	426.20	157.50
573.7	81,448.1	1,018.1	705.3	85,474.2	3,070.4	1,028.1	89,392.54	25,144.68
2.2	1,093.6	3.6	2.8	1,138.0	13.4	3.5	1,118.98	102.87
--	54.4	--	0.1	59.2	0.2	--	60.36	6.99
16.6	1,769.3	9.5	17.4	1,726.3	19.0	19.6	2,077.85	134.36
37.6	4,283.6	17.0	40.3	4,511.7	39.8	43.7	4,777.54	304.60
46.6	4,852.6	23.4	55.9	5,049.1	57.9	62.1	5,226.64	305.00
9.7	2,040.6	5.4	10.1	2,142.6	18.4	11.3	2,295.55	131.53
11.9	5,727.6	14.5	11.9	6,080.4	88.3	12.2	6,387.79	495.31

Table I

19293

19304

19314

Of These

Of These

Of These

Total	Collective	State	Total	Collective	State	Total	Collective	State
	Farms	Farms		Farms	Farms		Farms	Farms
19,589.5	4,169.3	1,819.0	127,766.73	38,340.20	3,852.6	137,515.4	80,444.8	10,596.9
25,543.8	928.7	719.2	28,362.9	11,252.2	993.7	29,350.0	18,268.0	2,151.0
3,491.7	40.7	39.5	3,021.61	488.42	67.29	3,831.1	1,329.0	108.7
2,232.3	43.0	8.0	2,472.02	362.0	16.50	2,462.2	832.2	70.0
1,892.1	68.0	21.3	2,595.96	802.50	45.10	2,560.7	1,378.4	119.8
603.7	6.7	0.3	895.5	132.90	10.00	858.1	438.1	30.5
351.7	11.8	2.6	426.20	157.50	5.4	414.0	229.0	16.5
85,474.2	3,070.4	1,028.1	89,392.54	25,144.68	2,714.56	98,039.3	57,910.1	8,100.3
1,138.0	13.4	3.5	1,118.98	102.87	4.45	1,122.5	420.5	14.0
59.2	0.2	--	60.36	6.99	--	49.7	17.7	0.1
1,726.3	19.0	19.6	2,077.85	134.36	27.13	2,068.5	746.0	66.5
4,511.7	39.8	43.7	4,777.54	304.60	41.10	4,895.9	2,003.2	120.9
5,049.1	57.9	62.1	5,226.64	305.00	154.62	5,585.5	2,055.8	291.4
2,142.6	18.4	11.3	2,295.55	131.53	23.4	2,288.8	876.0	75.9
6,080.4	88.3	12.2	6,387.79	495.31	25.32	6,210.7	2,108.5	57.1

Ural'sk Oblast		1930	5,427.4	20.4	14.7	5
Bashkir ASSR	--	--	2,494.6	6.0	10.9	2
Tartar ASSR.	--	No information	2,698.3	2.8	6.8	4
Central Volga Kray.	--	--	6,809.7	28.5	41.3	
Central Black Soil Oblast.	--	--	9,915.1	57.3	211.6	1
Lower Volga Kray	--	--	6,062.0	53.3	32.7	
North Caucasus Kray.	--	--	10,254.3	126.8	79.2	
Dagestan ASSR.	--	--	268.1	1.3	--	
Crimea ASSR.	--	--	810.9	22.1	16.7	
Kazak ASSR	--	--	4,298.5	24.6	11.4	
Kirgiz ASSR.	--	--	559.0	--	--	
Siberia Kray	--	--	8,553.2	51.0	23.5	
Buryato-Mongolia ASSR.	--	--	310.4	1.4	--	
Far East Kray.	--	--	1,408.3	8.1	0.3	
Yakutiya.	--	--	No information			

General notes: (1) Sowing areas for all the years, including 1913 are given with adjustments for underestimates. Totals sowings are given for all economy categories (peasant, collective farm, state farm, and organizations of country and city type).

- (2) Planting areas in the Union Republics except RSFSR for 1927-29 are given as "productive", for winter crop failures. For RSFSR and Gosplan, regional divisions "occupied" planting area is, winter crops are included with the deduction of the damage which has been replaced by spring planting area for 1930-31 in the Union Republics and the RSFSR are given as "productive". Totals for USSR for 1927-29 represent a sum of "occupied" (RSFSR) and "productive" (remaining) planting areas. What planting areas are given for 1925-26 in the "Handbook on USSR for 1926" data is taken), is not indicated. There is reason to assume, that "occupied" planting area unknown is what the planting area of 1913 represents.
- (3) Due to technical causes, the present table was compiled at the moment of the article's issue and the figures obtained on planting areas in other articles of this publication pertain to it. Therefore, the exact data on planting areas in various places may vary slightly.

5,427.4	20.4	14.7	5,231.4	80.6
2,494.6	6.0	10.9	2,631.6	16.8
2,698.3	2.8	6.8	2,747.5	10.3
6,809.7	28.5	41.3	7,465.3	58.6
9,915.1	57.3	211.6	10,152.1	71.4
6,062.0	53.3	32.7	6,430.2	99.0
10,254.3	126.8	79.2	9,883.2	304.9
268.1	1.3	--	276.1	3.8
810.9	22.1	16.7	762.2	28.6
4,298.5	24.6	11.4	4,474.5	80.8
559.0	--	--	674.1	8.6
8,553.2	51.0	23.5	9,053.4	150.5
310.4	1.4	--	328.0	4.1
1,408.3	8.1	0.3	1,516.8	26.7

No information

No informa

18.1	5,692.0	326.2	29.5
13.3	2,851.0	77.4	14.2
9.2	2,776.0	29.0	15.4
49.9	7,612.9	203.6	91.9
259.6	10,328.7	192.3	296.5
51.8	6,864.5	295.8	114.8
77.9	10,427.4	685.0	173.1
--	277.3	12.3	0.4
22.4	739.3	91.3	30.6
23.1	4,818.1	263.5	41.8
0.9	767.2	22.7	2.0
39.3	9,899.3	549.7	60.9
--	340.9	17.2	--
1.3	1,372.3	67.4	4.6

tion

No information

given with adjustments for underestimates. In the column of
 (peasant, collective farm, state farm, different institutions

for 1927-29 are given as "productive", that is with deduction
 regional divisions "occupied" planting areas are given. That
 the damage which has been replaced by spring crops. The
 and the RSFSR are given as "productive". Correspondingly, the
 "occupied" (RSFSR) and "productive" (remaining Union Republics)
 1925-26 in the "Handbook on USSR for 1928" (from where the
 to assume, that "occupied" planting areas are given. Equally
 ts.
 compiled at the moment of the article's issue from the printers,
 er articles of this publication pertain to earlier dates.
 rious places may vary slightly.

- (1) Data from the control figures of the
- (2) Data from the statistical handbook
 USSR, 1929. Data only on individual
- (3) Data on United Republics besides RS
 in USSR agriculture". Summary on U
 the data from "Sdvigi in USSR agric
- (4) Data for 1930-31 on United Republic
 NKZ USSR (People's Commissariat of
- (5) Data on RSFSR and rayons of the Go
 1925-26 -- see note 2, data for 19
- (6) Including Kara-Kalpakiya.
- (7) Data for 30-31 on Siberia Kray inc

18.1	5,692.0	326.2	29.5	6,270.45	2,138.63	116.59	7,135.1	5,138.9	616.5
13.3	2,851.0	77.4	14.2	2,933.31	535.53	97.38	3,534.3	1,895.8	244.4
9.2	2,776.0	29.0	15.4	2,902.71	220.18	27.4	3,110.6	1,375.5	84.3
49.9	7,612.9	203.6	91.9	8,776.2	2,322.9	411.20	9,897.1	6,291.8	1,228.3
259.6	10,328.7	192.3	296.5	10,763.76	1,692.79	390.84	11,029.2	5,579.9	627.4
51.8	6,864.5	295.8	114.8	7,741.13	3,781.01	375.62	9,178.6	7,540.9	909.7
77.9	10,427.4	685.0	173.1	11,879.91	6,995.18	390.86	12,403.1	7,509.5	1,494.5
--	277.3	12.3	0.4	340.49	34.44	13.70	333.7	89.8	18.3
22.4	739.3	91.3	30.6	866.65	407.3	83.85	949.7	549.1	197.5
23.1	4,818.1	263.5	41.8	4,638.9	2,453.9	202.81	6,093.5	4,599.0	747.2
0.9	767.2	22.7	2.0	808.73	250.46	18.99	1,013.7	447.4	60.3
39.3	9,899.3	549.7	60.9	8,616.8	2,534.5	255.1	10,115.4	6,065.2	1,061.3
--	340.9	17.2	--	--	--	--	--	--	--
1.3	1,372.3	67.4	4.6	866.8	392.2	54.2	973.1	574.4	182.9
	No information			42.1	5.0	--	50.8	16.0	1.8

Notes

- (1) Data from the control figures of the Gosplan for 1928/29 (see "Sdvigi in USSR agriculture")
- (2) Data from the statistical handbook of USSR for 1928, published by TsSU (Centr. Statistical Administration) USSR, 1929. Data only on individual collective farms with corrections of underestimates.
- (3) Data on United Republics besides RSFSR and without USSR on the whole are taken for 1927-29 from the "Sdvigi in USSR agriculture". Summary on USSR -- result of adding United Republics and RSFSR. This is done because the data from "Sdvigi in USSR agriculture", the Gosplan of USSR and Gosplan of the RSFSR do not coincide.
- (4) Data for 1930-31 on United Republics and rayons of the Gosplan is taken from the preliminary material of the NKZ USSR (People's Commissariat of Agriculture).
- (5) Data on RSFSR and rayons of the Gosplan for 1927-29 is taken from material sent by Gosplan RSFSR, data for 1925-26 -- see note 2, data for 1930-31 -- see note 4.
- (6) Including Kara-Kalpakiya.
- (7) Data for 30-31 on Siberia Kray includes the Buryato-Mongoliya ASSR.

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CHARTS OF ZONES AND DISTRICTS OF FIELD CULTIVATION IN THE USSR

CHIEF FIELD CROPS

Basic	Supplementary	Minor	Districts on the Map	Soils	Total Precipitation (in millimeters)		Comparative Air Moisture at 1 p.m. in June (in percentage)	Length Period Total the Average Above
					May-July	June-July		
A. NORTHERN CHERNOZEM ZONE								
1. <u>Tundra-Pasture Polar Zone</u>								
Utilizing basically reindeer moss and bottom land and swamp vegetation	In best localities, the early potato. Hothouse vegetable gardening. Oats, barley, vetch-pea mixtures for hay and green fodder. Island grass sowing.	Utilizing arboreal hay, sea plants, waste from hunting and fishing indus- tries. Wild berries and mushrooms.	I ₁ , II ₁ , tundra and forest-and- tundra of Asiatic USSR.	Undeveloped, weak soils of tundra and forest- and-tundra. Marshes. Permafrost.	100-150	55-90	very high	
3. <u>Zone of Bottom Land Pastures, Potato- Vegetable, Forage Crops, Barley-Rye.</u>								
Improved pasturage and hay fields. Barley, potatoes.	Early vegetables. Oat mixtures.	Winter and Spring rye. Turnips (<u>Brassica rapa</u> and <u>Brassica campestris rapifera</u>).	I _{2a} , I _{2b} , II ₂ , II ₃ , Northern Taiga, Arctic Circle area of Asiatic USSR.	Very podzolic, marshy and weak; in European USSR mainly arenaceous-loamy and gravelly; in the Western Siberian lowlands argillaceous-loamy soils, smaller in extent, in marshes further east; alluvial in the valleys.	150-160	90-110	60-64	
Improved pasturage and hayfields. Barley, rye. Potatoes	Spring wheat, oats. Oat mixtures. Early vegetables.	Turnips (<u>Brassica campestris rapifera</u>) White mustard.	XXII(1a), XXII(1b), XXII(1c), XXII(2a)	Weakly podzolic argilla- ceous-loamy, sometimes with solonets. Alluvial in valleys. Stony and peaty- podzolic in the mountain districts	70-110	50-120	Low	
(b) <u>Barley-rye-potato</u>								
Improved pasturage and hayfields. Barley spring rye. Potatoes	Oat mixtures. Grass sowing with clover.	Turnips (<u>Brassica campestris rapifera</u>), (<u>Brassica napus rapifera</u>). Spring wheat, peas, oats, Winter gold-of- pleasure.	I(3a), I(3b), I(4), and II(4).	Marsh soils, strongly podzolic argillaceous- loamy soils; along the rivers and in the west, arenaceous-loamy, in places gravelly.	150-175	110-130	58-66	
(c) <u>Rye-oats-barley, potato</u>								
Improved pasturage and hayfields. Winter rye, oats.	Potatoes, barley; in the southern part: clover, spring wheat	Turnips (<u>Brassica campestris rapifera</u> , <u>Brassica napus rapifera</u>). in southern part, flax	XI(6), XII(1).	Marshes; strongly podzolic argillaceous- loamy soils.	165-175	105-135	55-65	
(d) <u>Spring wheat-rye-oats-barley, potato</u>								
Improved meadow and pasturage. Spring wheat, winter and spring rye, oats. Improved meadow land and pasturage. Spring wheat, oats.	Potatoes, Barley. In the southern part: clover, flax. Barley, Spring rye, potatoes in the southern part, flax.	Hemp, peas. Winter rye, peas. Hemp.	XXI(1a), XXI(1) XXI(2a), XXI(2b) XXII(2b)	Podzolic argillaceous- loamy; alluvial in the valleys; peaty-podzolic and rocky in mountain sections.	115-165 110-130	100-110 85-110	--- 48-51	

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CHARTS OF ZONES AND DISTRICTS OF FIELD CULTIVATION IN THE USSR

CLIMATIC CONDITIONS

on the Map	Soils	Total Precipitation (in millimeters)		Comparative Air Moisture at 1 p.m. in June (in percentage)	Length of the Frostless Period. In Parentheses; Total Temperature of the Period with an Average Daily Temperature Above 10 Degrees (in days)	Average Temperature (in degrees centigrade)		Average Height of the Snow Covering at the End of Winter (in centimeters)	Natural Vegetation
		May-July	June-July			July	January		
A. NORTHERN CHERNOZEM ZONE									
1. Tundra-Pasture Polar Zone									
tundra t-and- SSR.	Undeveloped, weak soils of tundra and forest- and-tundra. Marshes. Permafrost.	100-150	55-90	very high	(0) - 85	2-14	-9.5 to -50.1	very small	Forestless tundra, scrub forest, and brushland of the forest-tundra.
2. Subarctic Pastures, Potatoes, Forage Crops, Barley-Rye.									
II ₂ , Northern Arctic Area of USSR.	Very podzolic, marshy and weak; in European USSR mainly arenaceous-loamy and gravelly; in the Western Siberian lowlands argillaceous-loamy soils, smaller in extent, in marshes further east; alluvial in the valleys.	150-160	90-120	60-64	70 - 90 (1000 degrees and less)	13-15	-11 to -22	small	Northern coniferous forests of the European USSR and the northern taiga of the Asiatic USSR. Mossy covering and absence
XII (1b), XII (2a)	Weakly podzolic argilla- ceous-loamy, sometimes with solonch. Alluvial in valleys. Stony and peaty- podzolic in the mountain districts	70-140	50-120	Low	11(1000-1500)	18.5 - 19.5	-36 to -45	Very small	of wide grasses; exceptional abundance of swamps. Exceptional vegetation on flood meadows.
(b) Barley-rye-potato									
b), I (4),	Marsh soils, strongly podzolic argillaceous- loamy soils; along the rivers and in the west, arenaceous-loamy, in places gravelly.	150-175	110-130	58-66	80-110 (1000-1400)	15-17	-10 to -20	40-70	
(c), Rye-oats-barley, potato									
I (1).	Marshes; strongly podzolic argillaceous- loamy soils.	165-175	105-135	55-65	100-120 (1400-1800)	17-19	-19 to -23	above 50	Southern belt of the western and central Siberian taiga.
Spring wheat-rye-oats-barley, potato									
II (1)	Podzolic argillaceous- loamy; alluvial in the valleys; peaty-podzolic and rocky in mountain sections.	145-165	100-120	---	less than 100 (1600-1700)	18.5 - 19.5	-21 to -23.5	30-40	Dry valley vegetation.
II (2b)		110-130	85-110	48-51	100 and less (1500-1700)	17-22	-22 to -32	?	Transitional district between the central and eastern taiga.

Flax-Oats-Rye-Barley.

(a) Clover-flax, rye-barley - potato.

Improved hayfields and pasturage. Clover. Winter rye, barley.	Oats. Flax Potatoes. Oat mixtures.	Winter wheat, peas	I(5b), I(6).	Podzolic-marshy, argillaceous-loamy and arenaceous-loamy.	150-175	120-140	54-56
(b) <u>Flax, Clover, Rye-Oats</u>							
Improved hayfields and pasturage. Winter rye, oats, clover, flax.	Barley, potatoes, oat mixtures	Peas	7a	Podzolic-marshy, argillaceous-loamy and arenaceous-loamy soils. Arenaceous along rivers.	175-200	130-160	53-56
(c) <u>Clover-rye-oats, flax</u>							
Improved pasturage and hayfields. Winter rye, oats. Clover	Flax. Barley. Potatoes, oat mixtures	Peas	I(5a), I(8a), II(5b), II(6b), II(7b).	Podzolic-marshy argillaceous, less frequently arenaceous-loamy and arenaceous. Large marsh areas.	160-200	110-150	56
(d) <u>Vegetable-potato, clover-root plants, oats (Leningrad environs)</u>							
Potatoes, vegetable crops. Clover. Oats.	Winter rye, barley, forage, root plants, oat mixtures	Peas	II(5a), II(6a), II(7a).	Weakly and strongly podzolic argillaceous-loamy soils on sedimentary rocks, moraine, limesonte, sometimes dense rocks occurring in their place of origin. Large marsh areas.	160-180	100-130	53-57
(e) <u>Flax-clover, oats-rye</u>							
Improved meadow and Pasturage. Oats, Winter rye, barley. In the south: clover flax.	Potatoes.	Peas; in the north: clover, flax.	XI(1).	Podzolic argillaceous-loamy and arenaceous-loamy, marshes, sands along rivers.	175-200	120-140	---

5. Zone of Flax-Clover, Oats-Rye

(a) Flax-clover, rye-oats, barley

Flax, clover, Winter	Potatoes. Peas, winter	Broad beans; also	II(8a), II(8b).	Podzolic arenaceous-loamy;	175-225	130-170	51-56
(b) <u>Flax-clover, rye-oats, potato-vegetable</u>							
rye, oats, technical and forage barley.	wheat.	in III(1): spring and winter vetch, field peas, seed lupine. Hemp, medicinal plants.	IV(1), III(1).	less frequently argillaceous-loamy and arenaceous soils and marshes.			
(c) <u>Flax-clover, oats-rye</u>							
Flax, clover. Winter rye, oats. Potatoes	Vegetables. Barley.	Peas, Spring and Winter wheat.	VI(1), VI(2a), VI(2b), VI(4a), I(7b), I(8b), VII(2a).	Podzolic, argillaceous-loamy and arenaceous-loamy, also arenaceous and marshy; alluvial in river valleys.	175-205	130-155	54-58
(c) <u>Flax-clover, oats-rye</u>							
Flax. Clover. Winter rye, Oats	Barley. Potatoes.	Peas. Winter and Apring wheat. Medicinal plants (in the south: buckwheat, fodder lentils)	II(9), IV(2), IV(3), V(1), northern part V(2), VI(3).	Various podzolic soils, chiefly argillaceous-loamy, less frequently arenaceous-loamy and arenaceous. Large marsh areas in the west, soils in transitional stages becoming chernozems in the east.	190-225	150-170	53-60
Clover. Flax. Winter rye, oats.	Barley. Potatoes.	Peas, spring and winter wheat (in the south: buckwheat, fodder lentils, medicinal plants).	VII(1), VII(2b), VII(3a), VII(3b), XI(2), XI(3a), XI(3b), X(2a).		150-200	110-150	---

Zone of Podzolic and meadows, fodder cropsFlax-Oats-Rye-Barley.(a) Clover-flax, rye-barley - potato.

(6)*	Podzolic-marshy, argillaceous-loamy and arenaceous-loamy.	150-175	120-110	54-56	100-110 (1400-1600)	16.5 - 17.5	-12 to -17	50-70	Coniferous forests with, very rarely, broad-leaved varieties and wide grasses; peaty marshes.
<u>Flax, Clover, Rye-Oats</u>									
	Podzolic-marshy, argillaceous-loamy and arenaceous-loamy soils. Arenaceous along rivers.	175-200	130-160	53-56	110-130 (1600-1800)	17.5	-12 to -16	52-65	
<u>Clover-rye-oats, flax</u>									
(8a)* II(5b)*	Podzolic-marshy argillaceous, less frequently arenaceous-loamy and arenaceous. Large marsh areas.	160-200	110-150	56	110-140 (1400-1700)	17-18	-10.0 to -11.5	40-52	
<u>Vegetable-potato, clover-root plants, oats</u>									
(Leningrad environs)									
II(6a)*	Weakly and strongly podzolic argillaceous-loamy soils on sedimentary rocks, moraine, limestones, sometimes dense rocks occurring in their place of origin. Large marsh areas.	160-180	100-130	53-57	110-140 (1400-1800)	17.0 - 17.2	-8.0 to -10.0	30-50	Coniferous and mixed forests, with broad-leaved varieties.
(e) <u>Flax-clover, oats-rye</u>									
	Podzolic argillaceous-loamy and arenaceous-loamy, marshes, sands along rivers.	175-200	120-140	---	110(1500-1600)	17	-17	70-90	Coniferous forests of the type of the Siberian taiga.
5. <u>Zone of Flax-Clover, Oats-Rye</u>									
(a) <u>Flax-clover, rye-oats, barley</u>									
II(8b)*	Podzolic arenaceous-loamy;	175-225	130-170	51-56	150 (1800-2200)	17.0 - 18.5	-7.5 to -9.0	30-40	Mixed forests with a large number of pine
III(1) . less frequently argillaceous-loamy and arenaceous soils and marshes.									trees and broad-leaved varieties.
<u>Flax-clover, rye-oats, potato-vegetable</u>									
(2a)* VI(2b)*	Podzolic, argillaceous-loamy and arenaceous-loamy, also arenaceous and marshy; alluvial in river valleys.	175-205	130-155	54-58	110-130 (1700-1900)	17.5 - 19.0	-11.0 to -14.0	52-60	Transitional zone between southern conifers and mixed forests of eastern and western types
<u>Flax-clover, oats-rye</u>									
(2)* IV(3)*	Various podzolic soils, chiefly argillaceous-loamy, less frequently arenaceous-loamy and arenaceous. Large marsh areas in the west, soils in transitional stages becoming chernozems in the east.	190-225	150-170	53-60	125-140 (1900-2100)	17.5 - 18.5	-9.0 to -11.5	40-50	Mixed forests of the central type.
2b* VII 3a*		150-200	110-150	---	115-140 (1700-2200)	17.7 - 19.3	-13.5 to -16.0	55-70	Coniferous forests with broad-leaved varieties and wide grasses, and mixed forests of the eastern type
2* XI 3a*									

8. Zone of Rye-Clover-Potato

(a) Rye-clover-potato, hemp

Winter rye. Clover, Potatoes. Hemp.	Oats. Lupine. Buckwheat.	Peas, field peas, vetch, beans, lentils. On more cohesive soils: winter wheat. Medicinal plants.	III ₂ , IV _{4a} , IV _{4b} .	Podzolic, arenaceous, and arenaceous-loamy; in the west, marshy; in the east, soils in transitional stages becoming chernozems.	200	160-180	57-60
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(b) Vegetable-potato-root plant, clover-oats
(Moscow environs)

Potatoes, vegetables, forage root plants, clover, oats.	Winter rye. Winter wheat.	Peas, spring wheat, Medicinal plants.	V ₂ , except for north- west part	Podzolic, argillaceous struc- ture; in the south, gray forest argillaceous-loamy soils.	175-200	150-170	52-57
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(c) Rye-clover-potatoes

Winter rye. Potatoes. Clover	Oats, buckwheat. Hemp, hops.	Peas, lupine, field peas, makhorka tobacco (<i>Nicotiana rustica</i>).	XX ₁ , XX ₂ .	Argillaceous-loamy arena- ceous podzolic soils and leached chernozems; marshes in the west.	200-60 - (plus)	160-60 - (plus)	58-60
Winter rye. Clover Potatoes	Oats.	Hemp. Peas, Buckwheat, lentils.	V _{3b} , VII ₄ , VIII ₂ , XIV _{1a} , XIV _{2a} , XVI _{1b} .	Podzolic arenaceous-loamy and arenaceous transitional to northern varieties of chernozems.	150-175	110-140	47-58
Winter rye. Clover Potatoes.	Oats.	Peas, buckwheat, lentils, vetch. Com- mon flax.	V _{2a} , VI ₅ , VII ₆ .	Podzolic arenaceous, less frequently argillaceous- loamy transitional to northern varieties of chernozems.	125-175	110-140	47-58
Winter rye, oats. Clover. Potatoes	Peas, lentils	Spring wheat, buck- wheat, vetch, vetchling. Flax. Caraway.	IX _{1a} , IX _{1b} .	Podzolic and podzolic transitional to northern varieties of chernozems	125-175	110-140	47-58

9. Zone of Clover-Potatoes, Vegetables, Oats-Rye
(Ural Mining Industrial Zone)

Improved pasturage and hayfields.	Vegetables, Potatoes. Barley.	In best localities: oats, winter rye, clover, Peas, Root Plants.	XI _{5a}	Heterogenous, strongly podzolic, gravelly, marshy; narrow belts of arenaceous and alluvial soils.	175-200	120-150	56-58
Potatoes. Vegetables. Clover Oats, winter rye.	Barley	Peas. Root plants.	XI _{5b}		175-225	150	54
Potatoes. Vegetables. Clover. Oats, Winter rye	---	Barley, Peas, Root plants.	XI _{5c}		175-200	140	52
Oats, Spring wheat. Potatoes, vegetables	Winter rye, clover.	Flax. Root plants.	XI _{5d} , X ₆ .		200-225	140-160	over 55

B. CHERNOZEM BELT OF EUROPEAN PART

10. Rye-Oats-Potatoes

(a) Rye-oats-potatoes-hemp

Winter rye, oats, Hemp. Potatoes	Hemp.	Winter wheat. Buckwheat. peas. lentils, clover with timothy, vetch-oats mixture; sunflower for silage; mangel-wurzel.	V ₄ , XVI _{1a}	Leached and degraded chernozems.	175-200	10-130	55-58
Winter rye.	Oats, potatoes. Hemp. Clover with timothy. Vetch-oats mixture, sunflower for silage, beets.	Vetch, spring wheat, buckwheat, taro lentils, peas, flax.	VII ₅ , VIII ₁ , XIV _{1b}		150-175	75-110	57

8. Zone of Rye-Clover-Potato

(a) Rye-clover-potato, hemp

III ₂ , IV _{4a} , IV _{4b} .	Podzolic, arenaceous, and arenaceous-loamy; in the west, marshy; in the east, soils in transitional stages becoming chernozems.	200	160-180	57-60	140-160 (2000-2400)	17.0 - 18.5	-6 to - 10	20 - 40	Western (with hornbeam, a large number of other broad-leaved varieties, and central mixed forest large areas of pine forests)
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(b) Vegetable-potato-root plant, clover-oats
(Moscow environs)

V ₂ , except for north-west part	Podzolic, argillaceous structure; in the south, gray forest argillaceous-loamy soils.	175-200	150-170	52-57	130 (2000)	18.5	-11.0	45	Central mixed with broad-leaved forests.
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(c) Rye-clover-potatoes

XX ₁ , XX ₂ .	Argillaceous-loamy arenaceous podzolic soils and leached chernozems; marshes in the west.	200-60 - (plus)	160-60 - (plus)	58-60	150-170 (2400-2500)	18-19	-5 to -8	20-40	Pine forests, mixed, with broad-leaved groves.
V _{3b} , VII ₄ , VIII ₂ , XIV _{1a} , XIV _{2a} , XVI _{1b} .	Podzolic arenaceous-loamy and arenaceous transitional to northern varieties of chernozems.	150-175	110-140	47-58	130 (2000-2200)	19.0 - 19.5	-11 to -14	45-60	Mixed forests with large numbers of pines on arenaceous soils.
V _{2a} , VI ₅ , VII ₆ .	Podzolic arenaceous, less frequently argillaceous-loamy transitional to northern varieties of chernozems.								
IX _{1a} , IX _{1b} .	Podzolic and podzolic transitional to northern varieties of chernozems	125-175	110-140	47-58	130 (2000-2200)	18.5 - 19.5	-14.0 to -15.5	45-70	Mixed with broad-leaved forests on the boundary of the forest-tundra.

9. Zone of Clover-Potatoes, Vegetables, Oats-Rye
(Ural Mining Industrial Zone)

XI _{5a}	Heterogenous, strongly podzolic, gravelly, marshy; narrow belts of arenaceous and alluvial soils.	175-200	120-150	56-58	90 (1000 and less)	14-16	-17.5 to -20.0	70-80	Coniferous forests of the Siberian type, and bare mountain vegetation of the Urals.
XI _{5b}		175-225	150	54	90-110 (1000-1400)	17.0	-16.5 to -17.5	55-70	
XI _{5c}		175-200	140	52	110 (1400-1700)	18.5	-15.0 to -16.0	40-60	
XI _{5d} , X ₆ .		200-225	140-160	over 55	110-125 (1700-2200)	15-18	-15.0 to 16.0	60-70	Coniferous forests with large number of pines in the eastern part; narrow leaved on felled areas.

B. CHERNOZEM BELT OF EUROPEAN PART

10. Rye-Oats-Potatoes

(a) Rye-oats-potatoes-hemp

V ₄ , XVI _{1a}	Leached and degraded chernozems.	175-200	10-130	55-58	143-148	19	-9 to -10	35-45	Groves and islands of broad-leaved forests (northern wooded steppe).
VII ₅ , VIII ₁ , XIV _{1b}		150-175	75-110	57	140-145	19-20	-12 to -15	40-50	

Winter rye.	Oats, potatoes. Hemp. Clover with timothy. Vetch-oats mixture, sunflower for silage, beets.	Vetch, spring wheat, buckwheat, taro lentils, peas, flax.	VII ₅ , VIII ₁ , XIV _{1b}	Chernozems.	150-175	75-110	57	
Winter rye, oats.	Spring wheat. potatoes. buckwheat, vetch-oats mixture, sunflower, and corn for silage.	Peas, lentils, vetch, in southern part, quickly ripening sunflower; clover with timothy, mangel-wurzel, carrots.	IX ₂ , X _{2b} , XIV _{2b}	(b) <u>Rye-oats-potatoes-spring wheat</u> Leached and degraded chernozems	125-150	100-110	53-55	
Spring wheat.	Winter rye, oats, potatoes. Clover for seed.	Hemp, Clover with timothy, vetch-oats mixture; sunflower for silage; turnips (<i>Brassica napus rapifera</i> , <i>Brassica campestris rapifera</i>).	X _{3b} , XI ₄ , X ₅	11. <u>Spring Wheat Zone</u> (a) <u>Spring wheat-oats-rye, clover-potatoes</u> (irregular moistening)	Over 175	100-110	51-53	
Spring wheat. Oats.	Buckwheat. Potatoes. Hemp.	Lucerne, brome grass, Alfalfa, Sudan grass, sweetclover; sunflower squash, mangel-wurzel, corn for silage.	X ₁	Leached and degraded chernozems.	150-175	90-120	around 55	
Spring wheat.	Rye, oats. The most quickly ripening sunflower seeds.	Buckwheat, peas; potatoes; lucerne, brome grass, Sudan grass, sweetclover, sunflower, squash, mangel-wurzel, corn for silage.	X _{3a} XIV ₃ , XIV ₄	(c) <u>Spring wheat-sunflower, rye-oats</u> (somewhat arid) Rich Chernozems. Rich chernozems.	125-150 110-130	90-110 80-100	50-53	110-
Spring wheat. sunflower.	Corn (only in XV _{2a}), oats, rye; in area marked*, Potatoes.	Alfalfa, brome grass, Sudan grass, sweetclover, sunflower, corn for silage, squash, water-melon	XV _{2a} , XIV _{5a} , X ₄ **	(d) <u>Spring wheat-sunflower-corn</u> (semi-arid) Ordinary chernozems.	110-135	85-110	47-50	115-
Spring wheat. Sunflower.	Corn (and barley in areas marked*)	Millet; Sudan grass, Zhityak (<i>Triticum cristatum</i>), corn, squash for silage, watermelon, chick-pea.	XIV _{5b} , XV _{2b} , XV _{4a} , XVII _{2a} *	(e) <u>Spring wheat-sunflower-corn</u> (arid) Southern Chernozems.	100-125 125-150	75-100	45-17	150-
Spring wheat.	Millet, corn, sunflower, watermelon.	Barley; chick-pea, bean (<i>Phaseolus acutifolius</i>), safflower; alfalfa, Sudan grass, sorghum, Zhityak (<i>Triticum cristatum</i>), sweetclover; corn, squash for silage.	XIV ₆ , XV _{3a} , XV _{4b} , XVII _{1a}	(f) <u>Spring wheat - millet - cucurbits</u> (very arid) Chestnut soils.	75-125	60-85	40-45	150-

12. Zone of Oasis Agriculture
(extremely arid)

II ₁ , XIV _{1b}	Chernozems.	150-175	75-110	57	140-145	19-20	-12 to -15	40-50	Wooded forests (northern wooded-steppe).
(b) Rye-oats-potatoes-spring wheat									
2b,	Leached and degraded chernozems	125-150	100-110	53-55	140-146	19.5-20	-13 to -15	50-60	Northern wooded-steppe (with islands of broad-leaved forests).
11. Spring Wheat Zone									
Spring wheat-oats-rye, clover-potatoes (irregular moistening)									
5	Leached and degraded chernozems.	Over 175	100-140	51-53	around 125	18-19	-15 to -16	60-70	Northern forest-steppe of the Siberian type (with birch "copses").
	Leached and degraded chernozems.	150-175	90-120	around 55	125-140	19-20	-12 to -15	40-50	Northern foothill steppe (with broad-leaved forests).
Spring wheat-sunflower, rye-oats (somewhat arid)									
	Rich Chernozems.	125-150	90-110	50-53	140-145	19.5-20	-14 to -15	40-50	Wooded steppe
XIV ₄	Rich chernozems.	110-130	80-100			20-21	-13 to -14	35-40	
Spring wheat-sunflower-corn (semi-arid)									
X ₄ **	Ordinary chernozems.	110-135	85-110	47-50	145-160	21-22	-9 to -14	30-35	Steppe, with varieties of grasses.
Spring wheat-sunflower-corn (arid)									
V _{2b} , II _{2a} *	Southern Chernozems.	100-125 125-150	75-100	45-47	150-170	22-23	-8 to -14	20-30	Steppe, with variety of grasses
Spring wheat - millet - cucurbits (very arid)									
XV _{4b} ,	Chestnut soils.	75-125	60-85	40-45	150-170	22-24.0 23-25	-10 to -15 -6 to -9	around 15	Southern feather-grass steppe.
Zone of Oasis Agriculture (extremely arid)									

Complex solonetz chestnut soils, predominantly solonetz.		50-100	30-70	below 40	150-175	24-25	-5 to -7	around 10	Grass-mugwort semi-wasteland
Winter wheat zone (sufficient moisture and milder climate)									
2b	Rich chernozems	around 175	110-130	51-53	150-165	20	-10 to -7	15-30	Wooded steppe
	Degraded and leached chernozems	175-200	100-110	53-55	160-170	19-20.5	-5 to -8	less than 15	Wooded steppe, with broad-leaved forests.
Sunflower-sugar beet									
	Rich chernozems.	135-160	110-125	51-52	140-150	20-21	-9 to -13	40-50	Wooded steppe
Wheat-Spring wheat-Corn-Sunflower-Barley (semi-arid)									
	Ordinary chernozems.	140-160	100-125	47-50	160-170	21-22	-8 to -10	15-30	Steppe, with a variety of grasses. Wooded steppe of the Donetsk Ridge.
	Ordinary chernozems	150-175	75-100	around 50	160-175	21-23	-5 to -7	less than 10	Steppe, with a variety of grasses.
	AZov-area chernozems.	140-175	75-100	47-52	175-190	23-24	-6 to -6	less than 10	Steppe, with a variety of grasses.
of vitreous Winter Wheats and Southern Malcol Crops (very arid)									
XX ₈ ,	Chestnut soils.	110-150	50-75	around 40	170-200	24-25	-4 to -7	below 10	Southern feather grass and grass steppe.
	Chestnut soils with solonchaks in the eastern part.	70-110	40-65	45-50	210-230	24-25	+1 to -2	below 5	Grass mugwort steppe and mugwort-saltwort semi-arid steppe; forests in river deltas in the south.

			<u>Technical Crops</u> (very arid)				
Winter wheat	Cotton in southern part, barley (partly winter).	Grain sorghum, corn, millet, castor plant, sesame, cucurbits, safflower chick-peas, beans (<i>Phaseolus acutifolius</i>); alfalfa, Sudan grass, Zhitnyak (<i>Triticum cristatum</i>) sorghum, corn, sweetclover, for silage; cucurbits	XVII ₃ , XIX _{1a} , XX ₃ , XVIII ₁	Chestnut soils.	110-150	50-75	around 40
			XVIII ₅	Chestnut soils with solontsy in the eastern part.	70-110	40-65	45-50
Rice; Kenaf, Kendyr, cotton.	Winter wheat and winter barley.	Soy bean, corn, peanut; on unirrigated lands: sorghum, millet, sesame, castor plant, cucurbits.	XVIII ₃ , XVIII ₄ , shallow river banks.	Salted meadow-marsh, meadow and Solonchak soils	110-170	?	around 40
16. <u>Winter wheat - corn</u>							
(a) <u>Winter wheat - corn - sugar beet - soybean</u>							
Winter wheat, corn, sugar beets	Barley for brewing, soybean, alfalfa, vetch mixtures, corn, soybean for silage, mangel-wurzel, potatoes.	Peas, buckwheat, kidney beans, winter and spring vetch.	XX _{3a}	Forest soils and degraded chernozems.	175-200	100-140	53-55
			XX _{5a}	Ordinary chernozems.	160-175		around 50
(b) <u>Winter wheat - corn - sunflower</u> (unstable moisture)							
Winter wheat.	Corn, sunflower seed, soybeans, castor plant, alfalfa, Sudan grass.	Fodder barley, spring durum wheat; cucurbits, kidney beans, safflower, corn, sorghum, soybean, beets, fodder carrots, for fodder: cucurbits.	XVII ₄ , XIX _{1b}	Azov-area chernozems	165-190	75-100	52-55
			XVII _{6a}	Chestnut, chernozem and rock soils.	150-190	90-110	around 45-50
(c) <u>Winter wheat - corn - soya and southern technical crops</u> (sufficient moisture)							
Winter wheat, corn.	Sunflower seeds, soybean, cotton (in the Anapa district), fodder barley; on the shallow riverbanks, rice.	Sugar beets, castor plant, kidney beans, Kenaf, peanuts, tobacco (<i>Nicotiana tabacum</i>), corn, sorghum, soybean, cucurbits; for silage. Beets, fodder carrots.	XVII _{5a} and XVII ₇ (shallow river bank)	Potent Azov-area chernozems.	190-225	100-125	55-57
Winter wheat, corn.	Soybeans, sunflower seeds, alfalfa, sudan grass.	Winter barley, potatoes, peanuts, southern hemp, tobacco (<i>Nicotiana tabacum</i>), esparsette, sweet clover; corn, sorghum, soybeans, cucurbits for silage; beets, fodder carrots.	XVII _{5b}	On eroded and degraded chernozems.	225-350	125-175	58-63
(d) <u>Winter wheat - corn - tobacco and fodder crops</u> (sufficient and abundant moisture)							
Winter wheat,	Tobacco, potatoes,	Oats, barley	XVII _{5b} , XVII _{6a} , XVIII _{7a}	On mountain forest and	More than 300	175-250	more than 63
	clover; corn for silage and green fodder.		XIX ₂	podsollic soils.			
<u>The Arid Southern Foothills of Dagestan</u>							
Winter wheat	Corn, barley, fodder	Potatoes, kidney	XVIII ₁ , XVIII ₂				
	cotton, kenaf,						

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Technical Crops (very arid)											
XIX _{1a} , XX ₈	Chestnut soils.	110-150	50-75	around 40	170-200	24-25	-4 to -7	below 10	Southern feather grass and grass steppe.		
	Chestnut soils with solontsy in the eastern part.	70-110	40-65	45-50	210-230	24-25	+1 to -2	below 5	Grass mugwort steppe and mugwort-saltwort semi-arid steppe; forests in river deltas in the south.		
XVIII ₄ , river	Salted meadow-marsh, meadow and Solonchak soils	110-170	?	around 40	190-210	24-25	-4 to -7	below 10	Mugwort-solonchak and marsh vegetation.		
16. Winter wheat - corn											
Winter wheat - corn - sugar beet - soybean											
	Forest soils and degraded chernozems.	175-200	100-140	53-55	160-170	18-20.5	-5 to -6		Western broad-leaved forests		
	Ordinary chernozems.	160-175		around 50	160-175	20.5 - 22	-5 to -6		Steppe, with a variety of grasses.		
b) Winter wheat - corn - sunflower											
XIX _{1b}	(unstable moisture) Azov-area chernozems	165-190	75-100	52-55	185-195	around 24	-2 to -4	below 10	Steppe, with a variety of grasses.		
	Chestnut, chernozem and rock soils.	150-190	90-110	around 45-50	around 200	23-23.5	-1 to -4	5-10	Mountain-meadow steppe and forests.		
Winter wheat - corn - soya and southern technical crops (sufficient moisture)											
XVII ₇ , river	Potent Azov-area chernozems.	190-225	100-125	55-57	190-200	22-24	-2 to -4	below 10	Steppe, with a variety of grasses.		
	On eroded and degraded chernozems.	225-350	125-175	58-63	170-190	20-22	-4 to -5	?	Foothill forest-and-steppe		
Winter wheat - corn - tobacco and fodder crops (sufficient and abundant moisture)											
XVII _{6a} , XVIII _{7a}	On mountain forest and podzolic soils.	More than 300	175-250	more than 63	170-175 and below	below 20	-5 and below	---	Broad leaved forests.		
Southern Foothills of Dagestan											
XVIII _{7b}	On mountain chestnut and chernozem soils.	130-150	65-90	---	around 190 and more	19-23	-1 to -3	---	Broad-leaved forest (in XVIII _{6a}), xerophyte, drought-resisting steppe.		

Winter wheat	clover; corn for silage and green fodder.	Potatoes, kidney beans	XIX ₂	podzolic soils.			
			The Arid Southern Foothills of Dagestan				
	Corn, barley; fodder plants; in parts with soils transitional to chernozems: early cotton, kenaf, Italian hemp		XVIII _{6b} , XVIII _{7b}	On mountain chestnut and chernozem soils.	130-150	65-90	---
Southern Technical Crops	Wild plants of the foothills: hay, clover, lotus, winter turnips (<i>Brassica campestris rapifera</i>)		17. Zone of Southern technical Crops				
			XVII _{6b} (south of Tuapse)	On brown-earth soils.	200-250	170-230	65-70
			XIX ₃		115-200	70-100	55-60
2. High-Mountain - Pasture Land Zone of the North Caucas							
			XVIII ₈ , XVIII ₈ , XVIII ₉				
			XVIII ₁₀				
C. WESTERN SIBERIA, THE TRANS-URALS, AND NORTHERN KAZAKHSTAN							
6. Zone of rye-oats-wheat, flax-clover-pasturage (taiga agriculture; Humid)							
Winter rye, oats, improved pasturage and hayfields.	Spring wheat. Flax, clover.	Potatoes, barley, peas, hemp, turnips (<i>Brassica campestris rapifera</i> , <i>Brassica napus rapifera</i>), vetch-oats mixture, sunflower for silage.	XI ₇ , XII _{2a} , XII _{2b}	Podzolic, often marshy	165-175	120-145	50-60
7. Zone of Summer Wheat - Flax - Rye - Oats, potatoes Root plants; with grass sowing. (sufficient moisture)							
Winter rye, oats, flax.	Spring wheat, barley, clover, vetch with oats, turnips (<i>Brassica campestris rapifera</i>), mangel-wurzel.	Potatoes.	XII ₁₀	Podzolic argillaceous-loamy and degraded chernozem.	160-180	140-150	50-55
Spring wheat, oats; natural meadow and pasturage.	Barley	Flax, hemp	XII _{2a}	Podzolic and gravelly.	175-250 and more	180-220	57 and above
Spring wheat, flax	Oats, rye, potatoes, clover, vetch with barley; sweetclover; vetch-oats, sunflower; for silage. Turnips (<i>Brassica campestris rapifera</i>), Mangel-wurzel.	Hemp	XII _{7a} , XII _{7b} , XII _{11b}	Degraded and leached chernozems.	160-185	130-150	57
Summer wheat, oats, flax. Natural meadows and pasturage	Winter rye, yellow and hybrid alfalfa, American couch grass, sweetclover, sunflower; for silage. Mangel-wurzel.	Peas, hemp, potatoes.	XII ₃	Marshy meadow soils, often salted.	150-160	115-125	59

podzolic soils.									
Mid Southern Foothills of Dagestan									
b, XVIII _{7b}	On mountain chestnut and chernozem soils.	130-150	65-90	---	around 190 and more	19-23	-1 to -3	---	Broad-leaved forest (in XVIII _{6b}), xerophyte, drought-resisting steppe.
Zone of Southern technical Crops									
(south of Tuapse)	On brown-earth soils.	200-250	170-230	65-70	200-250	22-23 degrees and more. 0 to +5	0		Southern-deciduous forests.
		115-200	70-100	55-60	200 and more				
High-Mountain - Pasture Land Zone of the North Caucasus									
b, XVIII ₈ , XVIII ₉	----	---	---	---	---	---	---	---	----
WESTERN SIBERIA, THE TRANS-URALS, AND NORTHERN KAZAKHSTAN									
Zone of rye-oats-wheat, flax-clover-pasturage (taiga agriculture; Humid)									
XII _{2a} , XII _{2b}	Podzolic, often marshy	165-175	120-145	50-60	120-125	18-20	-17.5 to -21	35-50	Western Siberian mixed (in the north) and deciduous (in the south) forests.
Zone of Summer Wheat - Flax - Rye - Oats, potatoes (sufficient moisture)									
XI ₁₀	Podzolic argillaceous-loamy and degraded chernozems	160-180	110-150	50-55	110-120	18-19	-18 to -20	25-30	Western-Siberian open Taiga.
XI _{9a}	Podzolic and gravelly.	175-250 and more	180-220	57 and above	100-115 and less	16-19	-14 to -19	25-30	Mountain taiga (chern') mixed and coniferous forests.
XII _{7a} , XII _{7b} , XII _{11b}	Degraded and leached chernozems.	160-185	130-150	57	around 120	18.5-19.5	-17 to -19	30 and over	Foothill western Siberian wooded steppe and open mountain taiga.
XII ₃	Marshy meadow soils, often salted.	150-160	115-125	59	120-125	17.5-20	-19 to -19.5	above 40	Meadow saliniferous wooded steppe.

wurzel.

11. Zone of Spring Wheat
(b) Spring wheat - oats with grass sowing

Spring wheat, oats.	Winter rye, flax, yellow and hybrid alfalfa, American couch grass, brome grass, sweetclover, vetch-oats mixture for silage, mangel-wurzel.	Potatoes, peas, hemp.	XI ₈ , XI _{9a} , XII ₄ , XII _{11b}	Leached chernozems.	140-180	100-125	46-52
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Spring wheat	Oats, sunflower, hemp, alfalfa, American couch grass, brome grass, sweetclover.	Vetch-oats, sunflower for silage, beets, fodder potatoes, sugar beets.	XII _{7b}	Degraded and leached chernozems.	160-190	130-150	50-55
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Spring wheat.	Oats, flax, hemp.	Sunflower	XIII ₉	Mountain-steppe, chestnut and chernozem soils.	150-200	115-135	---
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(d) Spring wheat - Oats - grass, with sunflower (semi-arid)

Spring wheat	Oats, quickly-ripening sunflower in southern part, grasses in northern part.	Oil flax, potatoes, yellow and hybrid alfalfa, American couch grass, brome grass, sweetclover; sunflower, corn for silage.	XI _{9b} , XII ₅ , XIII ₁ , XII _{11a}	Rich and ordinary argillaceous loamy chernozems.	125-160	90-110	45-50
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(f) Spring wheat - sunflower - oil flax (arid)

Spring wheat	Oil flax, millet, quickly-ripening varieties of sunflower seeds.	Yellow and hybrid alfalfa, American couch grass, brome grass, sweetclover, sunflower seeds and corn for silage	XI ₁₀ , XII ₆ , XIII ₂ , XII _{12b}	Southern argillaceous-loamy (and arenaceous-loamy in the Kustanay districts) chernozem soils, with patches of solontsy.	110-140	80-100	43-48
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(g) Very Arid (extremely unreliable oasis agriculture without irrigation)

Spring wheat, millet	Oil Flax	Sunflower seeds, the most quickly ripening corn, yellow and hybrid alfalfa, American couch grass, for silage; sunflower and corn.	XII _{8a} , XIII ₃ , XII _{12b}	Chestnut, argillaceous and argillaceous-loamy.	75-120	60-75	38-45
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Spring wheat.	Millet.	Sunflower seeds.	XIII _{3a} , XIII _{4a}	Elevated mound district, with gravelly dark- and light-chestnut soils.	80-130	75-85	40-45
Spring wheat.	Millet.	-----	XIII _{3b} , XII _{8b}	Light chestnut, arenaceous-loamy and arenaceous soils	-----	---	---

19. Non-Agricultural semi-wasteland Zone
(a) Extremely arid, oasis agriculture with irrigation

Spring wheat (only with irrigation); millet

Leached chernozems.	110-180	100-125	46-52	115-120	18.5-20	-16.5 to -19	35-40	Western-Siberian northern wooded steppe.
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Degraded and leached chernozems.	160-190	130-150	50-55	120-130	17.5-20	-13 to -17	---	Rocky and scrubby steppe of the Southern Altay foothills.
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Mountain-steppe, chestnut and chernozem soils.	150-200	115-135	---	120-110	17.5-20	-15.0 to -21.5	---	Mountain forests and foothill wooded steppe.
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- Oats - grass, with sunflower (semi-arid)

Rich and ordinary argillaceous loamy chernozems.	125-160	90-110	45-50	125-130	19-20	-17 to -19.5	30-35	Western Siberian wooded steppe and steppe.
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eat - sunflower - oil flax (arid)

Southern argillaceous-loamy (and arenaceous-loamy in the Kustanay districts) chernozem soils, with patches of solontsy.	110-140	80-100	43-48	120-110	19-20.5	-16 to -18	25-30	Steppe, with a variety of grasses.
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d (extremely unreliable oasis
ure without irrigation)

Chestnut, argillaceous and argillaceous-loamy.	75-120	60-75	38-45	130-150	20.5-23	-15 to -18	25-30	Southern-feather grass steppe.
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Elevated mound district, with gravelly dark- and light-chestnut soils.	80-130	75-85	40-45	120-110	19-22	-12 to -15	25-30	Southern-feather grass and grass-mugwort semi-wasteland steppe.
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Light chestnut, arenaceous-loamy and arenaceous soils	---	---	---	---	---	---	---	---
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gricultural semi-wasteland Zone
mely arid, oasis agriculture with
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Light-chestnut, with patches of solontsy.	80-100	45-55	33-40	135-145	23-25	-15 to -16	20-25	Grass-mugwort semi-wasteland.
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ximally arid

(f) Spring wheat - sunflower - oil flax
(arid)

Spring wheat	Oil flax, millet, quickly-ripening varieties of sunflower seeds.	Yellow and hybrid alfalfa, American couch grass, brome grass, sweetclover, sunflower seeds and corn for silage	XI ₁₀ , XII ₆ , XIII ₂ , XII _{12b}	Southern argillaceous-loamy (and arenaceous-loamy in the Kustanay districts) chernozem soils, with patches of solontsy.	110-140	80-100	43-48	120-
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(g) Very Arid (extremely unreliable oasis agriculture without irrigation)

Spring wheat, millet	Oil Flax	Sunflower seeds, the most quickly ripening corn, yellow and hybrid alfalfa, American couch grass, for silage: sunflower and corn.	XII _{8a} , XIII ₃ , XII _{12b}	Chestnut, argillaceous and argillaceous-loamy.	75-120	60-75	38-45	130-
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Spring wheat.	Millet.	Sunflower seeds.	XIII _{3a} , XIII _{4a}	Elevated mound district, with gravelly dark- and light-chestnut soils.	80-130	75-85	40-45	120-
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Spring wheat.	Millet.	-----	XIII _{3b} , XII _{8b}	Light chestnut, arenaceous-loamy and arenaceous soils	----	---	---	---
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19. Non-Agricultural semi-wasteland Zone(a) Extremely arid, oasis agriculture with irrigation

Spring wheat (only with irrigation); millet	---	---	XIII ₄	Light-chestnut, with patches of solontsy.	80-100	45-55	33-40	135-
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(b) Maximally arid

Agriculture without irrigation impossible			XIII ₅	Solonchak argillaceous light-chestnut soils, brown soils.	below 80	30-45	below 35	150-
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D. EASTERN SIBERIA AND THE FAR EAST7. Zone of Spring Wheat-Rye-Oats, and Flax(a) Spring wheat - rye - oats - flax

Spring wheat, oats, winter rye, flax	Barley, Spring rye, millet, buck-hemp.	Potatoes, peas, millet, buck-wheat.	XXI ₄ , XXI _{5a}	Slightly podzolic argillaceous-loamy isolated areas of chernozem varieties.	130-180	110-140	41-44	less (1600
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(b) Spring wheat - rye - oats - flax, potato-vegetable and fodder crops.

Spring wheat, oats, spring rye.	Vegetables, root plants. Barley, summer rye, hemp.	Peas, millet, buckwheat.	XXI _{5b}	Slightly podzolic argillaceous-loamy, gray forest lands and degraded chernozems, in places arenaceous.				
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11-h. Zone of Spring Wheat - Rye - Oats, and pasture.

Spring wheat, oats, spring rye.	Buckwheat.	Millet, barley. Potatoes.	XXIII _{4a} , XXIII _{4b} , XXI ₆ , XXI _{7a} , XXI _{7b}	Various mountain soils. Argillaceous leached soils, ordinary and southern chernozems, chestnut soils, in places solonetz.	85-200	75-170	34-45	around (1600
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Spring rye,	Potatoes.	Barley,	XXIV,	Peaty-marshy podzolic and				
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hybrid frican brome clover, eds and age	XI ₁₀ , XII ₆ , XIII ₂ , XII _{12b}	Southern argillaceous- loamy (and arenaceous- loamy in the Kustanay districts) chernozem soils, with patches of solontsy.	110-140	80-100	43-48	120-140	19-20.5	-16 to -18	25-30	Steppe, with of grasses.
eds, the y ripening w and hy- a, American , for si- lower and	XII _{8a} , XIII ₃ , XII _{12b}	Chestnut, argillaceous and argillaceous-loamy.	75-120	60-75	38-45	130-150	20.5-23	-15 to -18	25-30	Southern-feat steppe.
eds.	XIII _{3a} , XIII _{4a} XIII _{3b} , XII _{8b}	Elevated mound district, with gravelly dark- and light-chestnut soils. Light chestnut, arenaceous- loamy and arenaceous soils	80-130	75-85	40-45	120-140	19-22	-12 to -15	25-30	Southern-feat and grass-mu wasteland st
peas, ck-	XIII ₄	Light-chestnut, with patches of solontsy.	80-100	45-55	33-40	135-145	23-25	-15 to -16	20-25	Grass-mugwo wasteland.
et,	XIII ₅	Solonchak argillaceous light-chestnut soils, brown soils.	below 80	30-45	below 35	150-180	23-25	-10 to -15	15-20	Mugwort-sal wasteland.
barley.	XXI ₄ , XXI _{5a} XXI ₆ , XXI _{7a} , XXI _{7b} XXIV ₁	Slightly podzolic argil- laceous-loamy isolated areas of chernozem varieties. Slightly podzolic argil- laceous-loamy, gray forest lands and degraded chernozems, in places arena- ceous. Various mountain soils. Argillaceous leached soils, ordinary and southern chernozems, chestnut soils, in places solonchaks. Peaty-marshy podzolic and rocky mountain soils, very podzolic argillaceous- loamy soils, alluvial	130-180	110-140	41-44	less than 100 (1600)	17.0-19	-21 -24	10-25	Open (centr taiga, isla wooded step varieties o the steppe
	XXIII _{4a} , XXIII _{4b}	Various mountain soils. Argillaceous leached soils, ordinary and southern chernozems, chestnut soils, in places solonchaks.	85-200	75-170	34-45	around 100 (1600-2000)	19.5-22	-23.5 to 31.0	0-10	Steppes, v of grasses with the mountains feather g in the so wasteland
	XXIV ₁	Peaty-marshy podzolic and rocky mountain soils, very podzolic argillaceous- loamy soils, alluvial	160-200	120-250	34-45	around 100	18-21	-27 to -32	---	Narrow be

11-h. Zone of Spring Wheat - Rye - Oats, and Pasture.					
Spring wheat, oats, spring rye.	Buckwheat.	Millet, barley. Potatoes.	XXIII _{4a} , XXIII _{4b} , XXI ₆ , XXI _{7a} , XXI _{7b} , XXIV ₁	Various mountain soils. Argillaceous leached soils, ordinary and southern chernozems, chestnut soils, in places solonetz.	85-200 75-170 34-45
Spring rye, oats, spring wheat.	Potatoes.	Barley, Buckwheat.		Peaty-marshy podzolic and rocky mountain soils, very podzolic argillaceous-loamy soils, alluvial soils in the river valleys.	160-325 125-255 ---
11-j. Zone of Spring Wheat - Oats - Soybeans					
Spring wheat, oats	Potatoes.	Soybean (quickly ripening varieties), sunflower	XXIV ₄	Very podzolic argillaceous-loamy and alluvial soils of the slopes and valleys of the Amur, Zeya and Bureya rivers.	245-290 190-240 55
18. Zone of Soybean - Rice, Wheat, Technical Crops					
Spring wheat, oats.	Soybean, flax, hemp, rice, buckwheat. Potatoes.	Winter rye, corn, millet, sudza.	XXIV ₅	Podzolic argillaceous-loamy and alluvial soils of the valleys of the Amur, the Ussuri, and their tributaries.	275-290 200-225 61
Soybean, rice, spring wheat, oats.	Corn. Sugar beets, hemp, flax, buckwheat.	Paniceae, kidneybeans. Tobacco (<i>Nicotiana tabacum</i>), Sudza.	XXIV ₆	Podzolic soils of the slopes and alluvial soils of the Shufen-Ussuri lowlands.	220-320 175-225 64
2. Mountain Pasture Zone					

Improved pasture and hayfields, oats, barley, spring rye, potatoes.	Vegetables, Spring wheat.	Winter rye.	XXI ₈ , XXIII ₂	Skeletal, rocky, peaty-podzolic soils; alluvial soils in the valleys; podzolic argillaceous-loamy soils in the foothills; in places, sands, some blown about, and solontsy.	130-200 105-170 39
Improved pasture and hayfields, oats, spring rye, spring wheat.	Potatoes, Barley, badan (<i>Bergenia crassifolia</i>), hemp.	Winter rye, peas, quickly ripening millet.	Eastern mountain parts: XXI _{2b} , and XXIII ₁		110-170 85-135 43-51
Improved pasture and hayfields, barley.	Oats, spring rye.	Potatoes, vegetables, spring wheat.	XXI ₃ , XXII _{1b} , XXII _{1c}		70-140 50-120 48-51
Improved pasture and hayfields. Oats, spring rye, barley	Spring wheat. Potatoes, vegetables badan (<i>Bergenia crassifolia</i>)	Quickly ripening millet, buckwheat, hemp.	XXI ₉ , XXIII ₃		130-165 90-150 36
Improved pasture and hayfields. Barley, oats, Spring rye.	Potatoes, vegetables, spring wheat.	Hemp, winter rye.	XXIV _{3a} , XXIV _{3b}		145-350 110-300 61-67

E. CENTRAL-ASIATIC REPUBLICS, SOUTHERN KAZAKHSTAN AND KIRGIZIA

19. High-Mountain and Waste-Land Pasture

XXV ₈ , XXVI ₈ , XXII ₁₁ , XXII ₁₂ , XXVI ₁₂ , XXVII ₁₂	Mountain-meadow and mountain-steppe soils on the mountain sands, solonchak and solonchaks.
---	--

Almost no agriculture

Spring Wheat - Rye - Oats, and

29.

Various mountain soils. Argillaceous leached soils, ordinary and southern chernozems, chestnut soils, in places solonchaks.

85-200

75-170

34-45

around 100
(1600-2000)

19.5-22 -23.5 to 31.0 0-10

Steppes, with varieties of grasses alternating with the taiga on the mountains, mugwort and feather grass steppes; in the southeast, semi-wasteland.

Pesty-marshy podzolic and rocky mountain soils, very podzolic argillaceous-loamy soils, alluvial soils in the river valleys.

160-325

125-255

around 100
(1600-1800)

18-21 -27 to -32 ---

Narrow belts of open taiga and wide river valleys alternating with mountain taiga (of the maritime and Uda type).

Spring Wheat - Oats - Soybeans

Very podzolic argillaceous-loamy and alluvial soils of the slopes and valleys of the Amur, Zeya and Bureya rivers.

245-290

190-240

55

100-120
(2200)

21-22 -23.5 to 28.0

10-15
amur an

Meadow steppes of the Amur and northern Ussuri areas.

Soybean - Rice, Wheat, Technical Crops

Podzolic argillaceous-loamy and alluvial soils of the valleys of the Amur, the Ussuri, and their tributaries.

275-290

200-225

61

120-130
(2200-2500)

20-21 -21.3 to -22.4

40-60

Meadow steppes of the Amur and northern Ussuri areas.

Podzolic soils of the slopes and alluvial soils of the Stufen-Ussuri lowlands.

220-320

175-225

64

120-150
(2500 and more)

20-22 -16.0 to -23.5

40

Meadow steppes of the Ussuri area. Open expanses of the Southern Ussuri taiga.

Pasture Zone

130-200

105-170

39

100 and less
(1600 and less)

16-18 -18 to -27

Mountainous Sayan taiga, alpine and tundra vegetation in higher areas, peaty marshes.

110-170

85-135

43-51

100 and less
(1500-1700)

17-22 -22 to -30

Central Siberian taiga.

70-140

50-120

48-51

100 and less
(100-1700)

18-22 -22 to -45

Eastern Siberian taiga

130-165

90-150

36

100 and less
(1500-1600)

15.5 - -20.5 to 20.0 -27.0

0.20

Dauriya taiga

145-350

110-300

61-67

less than 100
and up to 110
(1600-2200)

14-20 -11.5 to 32.0

Amur, Ussuri, and Maritime taiga.

ASIATIC REPUBLICS, SOUTHERN KAZAKHSTAN
SIZIA

Mountain and Waste-Land Pasturage

8. XXII. 11.

Mountain-meadow and mountain-
soils on the mountain

Oats, spring rye, barley	badan (<i>Bergenia crassifolia</i>)	hemp.			
Improved pasturage and hayfields. Barley, oats, Spring rye.	Potatoes, vegetables, spring wheat.	Hemp, winter rye.	XXIV _{3a} , XXIV _{3b}	145-350 110-300	61-67

E. CENTRAL-ASIATIC REPUBLICS, SOUTHERN KAZAKHSTAN AND KIRGIZIA

19. High-Mountain and Waste-Land Pasturage

Almost no agriculture	----	----	XXV ₈ , XXVI ₈ , XXII ₁₁ , XIII ₁₂ , XXVI ₉ , XXVII ₉ , XIII ₁₀ , XIII _{10a}	Mountain-meadow and mountain-steppe soils on the mountain sands, solonchak and salted serozems on the Turan low-lands.	30-200 20-30	20-35 4-20	? ?
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20. Grain and Technical Crops, Bogara Agriculture

Winter and Spring wheat.	Oats, barley, opium poppy, tau-saghyz, alfalfa, sugar beet.	Millet, corn, sunflower seeds.	XIII _{8a}	Mountain-steppe: chernozems, chestnut soils, and serozems, often rocky.	55-100	10-30	?
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21. Grain, Technical Crops, and Quickly-Ripening Cotton, on Irrigated Land

Quickly-ripening varieties of cotton, Kenaf (both only in the south); sugar beet, winter wheat.	Indian hemp, abutilon, sesame, opium poppy; alfalfa; castor plant, hemp.	Soybean, peanut, buller's teasel, sunflower, corn; cucurbits, barley, sorghum.	XIII _{6a} , XIII _{6b}	Serozems, in places salted.	25-80	25-35	40
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22. Rice, New East and Wheat Crops

Rice, Kendyr; Cotton only in the south.	Kenaf, alfalfa, wheat, millet, sugar beet.	Abutilon, soybean, sesame, cucurbits; "mogary" sweetclover, sorghum, barley.	XIII ₇	Salted meadow soils, takyry (dense, sponge salted soils), solonchak.	20-60	20-30	37-40
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23. Grains with Bogara Agriculture, Cotton with Bogara Agriculture and Irrigated Lands.

Winter and spring wheat.	Cotton, alfalfa, tau-saghyz, barley.	Essential oils: lavender, muscatel sage; sesame, oil flax, safflower, chick-pea.	XXV ₆ , XXV ₇ , XXVI ₆ , XXVI ₇ , XXVII ₃ , XXVII ₄	Serozems, chestnut and chernozem soils.	May-June 75-150	0-15	35-40
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24. Medium-Late and Medium-early-ripening Cotton on Irrigated Lands

Cotton	Alfalfa; with bogara agriculture, wheat, barley.	Kenaf, Kendyr, Alexandrian Clover, rice, Volatile-oil plants, legumes for enriching land, peas, vetch, cucurbits.	XIII _{6d} , XXV ₁ , XXV ₂ , XXV ₄ , XXVII ₂ , XXV ₅ , XXVI ₅ , XIII _{6c}	Typical and waste-land serozems, in part salted meadow and meadow-solonchak soils in the valleys.	15-50	0-2-	32
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25. Medium-Late and Late Cotton

Cotton.	Alfalfa	Alexandrian clover, volatile oil plants, peas and vetch for enriching the soil.	XXV ₆ , XXVI ₂ , XXVII ₃ , XXVI ₄	Same soils as entry preceding plus takyry (sponge salted soils).	10-30	0-6	20-32
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26. Sub-Tropic Crops and Late-ripening cotton

Cotton.	Alfalfa, guayule, new sub-tropical crops.	Alexandrian clover, volatile oil plants, peas and vetch for enriching the soil.	XXVII ₁ , XXVI ₁	Salted gypsiferous serozems.	10-20	0-6	---
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3b		145-350	110-300	61-67	less than 100 and up to 110 (1600-2200)	14-20	-11.5 to 32.0	---	Amur, Ussuri, and Maritime taiga.
ASIATIC REPUBLICS, SOUTHERN KAZAKHSTAN									
Mountain and Waste-Land Pasturage									
XXII ₁₁ , XXVII ₅ , 10a	Mountain-meadow and mountain- steppe soils on the mountain sands, solonchak and salted serozems on the Turan low- lands.	30-200 20-30	20135 4-20	? ?	0-140 160-250	5-20 25-30	-8 to -17 -0 to -15	---	Alpine and subalpine meadows, fir forests and deciduous brushwood on the mountains. Wasteland vegetation in the Turan lowland.
and Technical Crops, Bogara Agriculture									
	Mountain-steppe: chernozems, chestnut soils, and serozems, often rocky.	55-100	10-30	?	140-160	20-24	-4 to -8	---	Grassy steppes, with step shrubs and deciduous forests.
Technical Crops, and Quickly-Ripening on Irrigated Land									
b	Serozems, in places salted.	25-80	25-35	40	160-180	24-27	-8 to -10	---	Mugwort steppe.
Wheat and Wheat Crops									
	Salted meadow soils, takyry (dense, sponge salted soils), solonchak.	20-60	20-30	37-40	160-180	24-27	-8 to -10	---	Black haloxyla, Solon- check bottom-land shrubs, meadows, and reeds on shallow banks.
Bogara Agriculture, Cotton with Agriculture and Irrigated Lands.									
VI ₆ , XXVII ₄	Serozems, chestnut and chernozem soils.	May-June 75-150	0-15	35-40	160-180	24-27	0 to -4	---	Steppes with varied grasses, steppe shrubs and deciduous forests.
Early and Medium-early-ripening Cotton on Lands									
XXV ₂ , XXV ₅	Typical and waste-land serozems, in part salted meadow and meadow-solonchak soils in the valleys.	15-50	0-2	32	180-210	25-28	0 to -5	---	Wasteland steppe
Early and Late Cotton									
XXVII ₃	Same soils as entry preceding plus takyry (sponge salted soils).	10-30	0-6	20-32	210-250	28-31	-2 to +2	---	Wasteland steppe
Crops and Late-ripening cotton									
	Salted gypsiferous serozems.	10-20	0-6	---	210-250	28-31	-0 to +4	---	Wasteland steppe.

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In the table the unutilized heat is counted from the time of yellow ripening (yellow ripening is taken in view of the lack of data concerning full ripening in available growing material,) so the data we have cited does not pretend to exactness until the arrival (in the curve of the yearly temperature course) of a ten-degree temperature, and we relate in percentage this unutilized heat to the general amount of heat within that temperature. But the period from the yellow ripening until the end of harvesting, lasting several days, cannot be considered lost time, so the percentages of unutilized heat given in the table are somewhat exaggerated. Nonetheless, considering that with mechanized harvesting this period is very short, as experience on the grain sovkhozes has shown, the exaggeration which we have permitted is, at all events, not large. So it appears that for the more southern latitudes of 50 degrees the loss of heat in summer grain cultivation exceeds 40 percent, and in winter grain cultivation 50 percent.

There are cultivated plants which have hitherto grown only when the temperature permitted (^{cucurbits} ~~melons~~, tobacco, root plants, tomatoes, cotton, the castor plant, and others), or plants the length of whose growing period varied greatly, so that one might choose a variety for a given place which would completely utilize all the active heat (corn, the soy bean). Hence, the correct selection of species and varieties of cultivated plants may achieve the utilization of all available heat resources.

In certain cases, however, the distribution of precipitation during the growing season is such that only early-ripening varieties may escape the effects of drought, although thermal conditions also allow later-ripening varieties to ripen, which one may observe in corn growing in the southwest. On the other hand, the later-ripening plants sometimes provide more stable yields, for they escape the effects of the

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spring drought, utilizing precipitation of the second half of the growing season which is unavailable to early-ripening plants.

Finally, in conditions of a subtropic climate, when vegetation is possible the year round, it is evident that maximum utilization of heat is possible with the introduction into cultivation of two types of plants: those needing heat, for the summer, and those not needing heat for the winter. The current practice is to cultivate one plant, or one type or another, and thus either not to utilize the heat of the cold half of the year (in cultivation of corn and cotton) or to utilize very little the warm part of the year (winter wheat). Such a method of cultivation is customarily seen in the Caucasus and in Central Asia. ■

In the matter of allocating crops, it is necessary to consider, further, their temperature optimum, for a serious rise in temperature may mean the poor utilization of plants, lowering the yield and weakening resistance to pests. In temperate countries, all grains, root plants, plants of the mustard family, the pea, flax, the potato have a rather low optimum, in any case lower than 20 degrees Centigrade. Therefore the cultivation of these plants in the south for the hot part of the year is evidently not expedient. In southern countries all these plants are cultivated in the cold half of the year and in North America there is even a term "cold-season crops." In conditions of the south of the USSR (the Ukraine, the Crimea, the Caucasus, Turkestan), all these plants and those similar to them grow well in the spring and autumn, while in warm months their growth is clearly inhibited -- yet just these plants are basic crops there.

Further, it is known that the harvest of grains in temperate lands with sufficient precipitation is greater when "bushing" takes place more energetically. "Bushing" is possible when the temperature is within 5

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and 10 degrees Centigrade. Above 10 degrees, the grains grow in a tube form. (Toporkov, "An Approach to the Biology of Winter Wheat," Agriculture and Forestry, ¹⁸⁹⁹). Consequently, the longer the period of cold temperature the stronger is the "bushing" and the larger the harvest. That is why we have such large harvests of wheat and other grains in Western Europe, larger as one travels further west, where there is a longer period of possible "bushing." In Russian agricultural literature the high harvests are attributed exclusively to fertilizer and techniques of cultivation, although climatic conditions play a large role here. Actually, the "bushing" period of winter wheat in England, owing to the high winter temperature and the sea climate, lasts around half a year, whereas in our land -- with the exception of the Caucasus and the Crimea -- by virtue of our continental climate, the period of "bushing" is limited to only 1-2 months. On the other hand, subtropic and, especially, tropic plants begin vegetation in high levels of temperature, many of them noticeably growing only in temperature of higher than 15 degrees, with the warm temperature of the south almost optimal for them. The development of these crops is less organized in the south, however, which is the more incomprehensible in view of their drought-resistability, whereas plants of temperate countries are exacting in their water needs and stand up poorly in droughts of the south.

Temperature and soil conditions being equal, the yield of summer grain, as is well known, is determined by the supply of water in the soil during the growing period, which in turn depends upon the amount of precipitation during this period. (For winter grains and certain summer grains the winter precipitation is also important.)

Numerous calculations by David, Shchukin, Ravich, Vyazovskiy,

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Sofoterov, Kurmangalin, and others, as to the dependence of the cereal grain yield on precipitation agree in finding a ^{high} ~~high~~ correlation coefficient for summer wheat exceeds ^{ing} 0.8; American research has found the same dependency true for corn. Investigations by linen growers have shown the same for linen also. For the sugar beet, it is known that its yield in the south is directly proportional to the amount of precipitation during the warm months. Thus, it is evident that, other conditions being equal, the cultivation of a given plant ought to be centered where there is the optimum of moisture for it during the growing period. In practice, the poorness of the soil elsewhere and the aspiration to have for our economy all necessary products has impelled us to engage in cultivation in districts where the growing period was not provided with the necessary amount of moisture. For these reasons, cultivation of cereal grains has been moved to the Black Earth Area, not considering that the climate of the Black Earth belt is less favorable for it than the climate of more northern zones with their poorer soils.

Within the limits of the relationships we have pointed out, the selection of crops is obviously determined by the totality of conditions of our ^{national} ~~economy~~ economy -- but this already goes beyond the scope of this work.

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AN AGRICULTURAL EVALUATION OF CLIMATE

Taking into consideration all available information as to the needs of crops as regards climate, we may determine that we ought to make the first approximation to an agricultural evaluation of climate from the following indexes:

1. The amount of active (utilized) heat during the growing season.
2. The level of temperature in the hottest month (the period of greatest growth).
3. Wintering conditions (frequency of low temperatures and the nature of the snowcovering).
4. ^{Assurance} ~~Assurance~~ of moisture during the growing period.

One may determine the amount of heat which a plant can utilize from the moment at which the temperature stays long enough at a certain level to cause the beginning of growth, which, as we pointed out above, varies between 5 and 15 degrees Centigrade. For the majority of crops, the temperature causes growth to begin at about 10 degrees, and the appearance of this sufficiently constant temperature may be rather safely predicted from the curve of the normal yearly course of temperature. The thermal termination of the growing period is more difficult to determine, since in the majority of cases, because of the disparity between the biological features of the plant and the climatic conditions in the place where it is cultivated, as was pointed out above, the plants cease growing long before the recurrence of the temperature which began their growth. However, many crops (melons, root plants, corn, cotton, the kidney bean, the tomato, and perennial plants) clearly time the end of their vegetation with the advent of their original growing temperatures, which may be considered to be

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12-15 degrees Centigrade for many of them. On the other hand, the grain cereals of temperate lands definitely do not ripen in the north with temperatures of less than 10 degrees, so this temperature may, as a first approximation, be considered also the temperature of the end of their vegetation. For winter grains, some root plants, cabbages, and perennial grass plants, the end of vegetation as well as its beginning come at approximately 5 degrees Centigrade. Thus, adding up the temperatures between 15 and 5 degrees may exactly enough ascertain the amount of actually utilized heat for the majority of crops.

Nevertheless, this amount is in certain cases less than the total of temperatures during the indicated period, since spring and especially autumn frosts may shorten vegetation prematurely.

Comparison of the average dates of the first and last frosts and dates of the advent and disappearance of a constant average temperature of 10 degrees Centigrade shows that on the average there two pairs of dates almost coincide. In littoral zones the average frostless period is longer than the period of 10 degree temperature, but in sharply continental and moreover more southern districts it is definitely shorter. For the western Trans-Caucasus, Central Asia, and Kazakhstan, and also evidently also for Siberia, the average frostless period is shorter than the 10 degrees period by 10-20 days, and, approximately, coincides with the constant 12 degree temperature period -- i.e., with the beginning and end of the growing season of corn. In littoral districts, the average frostless period is longer than the 10 degree period by 30-50 days. The absolutely frostless period in general coincides with the 15 degree period, except for littoral districts. Unfortunately, the length of the frostless period has been very poorly worked out in general by climatologists, and in addition it is not clear if the growing season ought to be

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considered coincidental with the average frostless period, as the Americans do (the American conception of "killing frost" is not entirely clear, but in general the dates of the "killing frost" coincide with the dates of the average frost) or with the period of the definite recurrence of the first and last frosts, taking into account their intensity. (A map in the "Atlas of American Agriculture" predicts the probable recurrence of spring freeze-overs within 10 percent.)

The conception of a "harmful" first frost is unfortunately still not established. Doubtless the average frostless period for cotton in our new districts is much longer than that actually utilized by cotton plants, whereas in America the average frostless period coincides with the growing season of the cotton plant.

Taking all this into consideration, one may, as a first estimate, consider the average growing season to be provided with sufficient heat in the period bounded by the 10 degree temperatures. The total amount of temperature in this period is less than that during the period within the 5 degree temperatures by 250-500 degrees, because of our continental climate, and exceeds the 12 degree period by 200 degrees and the 15 degree period by 500 degrees, except for littoral districts in the Far North.

The average temperature of the hottest month gives us an adequate idea of temperature levels during vegetation through the boundaries of certain crops -- for example, ^{flax} ~~linen~~ -- is better correlated with the June temperature.

A climatic evaluation of wintering conditions is at present still not worked out. For conditions of snowless winters (the subtropics), one may evaluate wintering conditions as the average of the absolute yearly minimums of temperature, taking into consideration the month of January, since the recurrence of heavy frosts ("harmful" frosts) is

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closely linked with the amount of frost in this month. One may, practically, consider that the average of the absolute yearly minimums will give about 50 percent of the probability of appearances of these January lowest temperatures. And the difference between the average minimum and the January temperature gives an indication of other instances of low temperature.

For snowy winter conditions, such an evaluation of wintering conditions is only suitable to wood plants. For plants wintering under the snow, wintering conditions are determined also by the condition of the snow and its change during the winter, and in addition by the condition of the spring thaw.

It is best to evaluate conditions of moisture supply by considering its income and outgo during growing months -- which may be considered as being, for the majority of crops, May, June, and July, excluding those in the southern latitudes.

Calculating only the amount of precipitation, as we may consider already proved, does not give a correct idea of the supply of moisture, because it is very necessary to consider the loss of water through evaporation. In view of the lack of data on actual evaporation in field conditions and the sparseness of material on humidity, one may get some idea of the relation between income and outgo of moisture by the method of the present author -- dividing the total temperature for the month by ten, then dividing this by the corresponding total precipitation (G. Selyaninov, "Developing Methods of Agricultural Climatology," Proceedings of the Institute of Agricultural Meteorology, Volume 22). But since evaluating moisture supply by total precipitation is among agronomists very common and persistently held to, we include here a chart showing the disposition of the total amounts of precipitation for May through July,

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material which demonstrates that such a comparison cannot be made when temperature conditions differ.

Table 4

Moisture balance:	1.0 - Moderately 1.5 - Too		
	0.5 - Dry	Humid	Humid
Temperature:	Precipitation in millimeters		
10 degrees Centigrade, Far North	15	30	45
15 degrees, North	22	45	67
20 degrees, Central Black Earth Area	30	60	90
25 degrees, North Caucasus	37	75	112

Thus, the same effect, as regards moisture supply, is produced by very different totals of precipitation on different levels of temperature. It is clear that one may deal with precipitation totals only when temperature conditions are similar -- a 5 degree difference in temperature significantly changes the value of precipitation.

Thus a monthly total of 50 millimeters precipitation is entirely sufficient in the north (Moscow), definitely too much in the Far North (Khibini), and not at all enough in the extreme south (Transcaucasia) -- assuming, of course, similar soil conditions.

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CLIMATIC MINIMUMS AND OPTIMUMS FOR CROPS

In order to draw up a chart of the climatic limitations of crops, it is essential that we know what the certain minimums relating to the climatic indexes enumerated above, essential for cultivating any crop and for providing an acceptable average harvest. Concretely, we need to know: (1) the temperature which causes growth to begin; (2) the minimum total of active temperature allowing the cycle of growth to be completed; (3) the minimum low temperature, the temperature of frost damage; (4) the minimum relation between the income and outgo of moisture during the growing season; and (5) the limiting high temperatures.

Taking into consideration that every plant begins growth at a certain temperature and has a certain period of growth, which we may take as the period from sowing until flowering, it is necessary, in order to utilize this data for determining the boundaries of crops, to draw up for every crop a chart of the distribution of temperature minimums from the date when the temperature appears which initiates growth, considering also "harmful" freeze-overs. And for every crop we should draw up a chart of changes in the moisture balance from the moment growth begins until the moment of gathering together the total amount of temperature, necessary for flowering to occur, when growth is reduced or weakens. It is to be regretted that for carrying out this work there is, in the first place, insufficient exact information on temperatures which initiate growth (as is pointed out above); in the second place, for many plants minimum temperatures for the entire growing period are not known, from sowing until flowering especially; finally, moisture needs and critically low temperatures are little known.

Therefore, for the present there remains nothing more to do than to slightly simplify and systematize the solution of the problem, dealing

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with average quantities which include the most important climatic moments in the life of a plant. The total amount of temperature above 10 degrees may be considered such a synthesizing quantity conditionally expressing the sum of the plant's general needs for amount and level of temperature. Since the total temperature is obtained by multiplying the length of the growing period with the average level of temperature for this period, and since a ten-degree temperature may be considered the average growth-initiating temperature of cultivated plants in general, the total of temperatures above this level may be used in estimating the heat supply practically utilized in agriculture.

This supply has been, in the past, generally considered to be the sum of temperatures of the period bounded by the 5 degree temperatures, 5 degrees being considered the temperature initiating growth of grains in temperate lands -- but actually only winter grain utilize heat within these temperatures and even these did not utilize much of the heat from the time of their ripening until the beginning of winter. Summer grains of temperate countries though, utilize much less heat during the 5 degree period than that available on their northern boundary, whereas above 10 degrees the actually utilized heat is closer to the total amount of heat. On the northern boundary of wheat, in places of the furthest northward advance on the whole world, the total temperature within 10 degrees varies from 1700 to 1500 degrees, and this total is exactly typical for wheat. (According to data of Russian experimental stations. In conditions of dry climate this total drops to 1400 degrees.)

If, thus, we determine reliable total temperatures within 10 degrees for the northern and mountain boundaries of all agricultural crops in the entire world, we may find climatic minimums for every crop, expressed in compared units -- i.e., of 10-degree temperatures. (G. Selyaninov,

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"Developing Methods of Agricultural Climatology," Proceedings of the Institute of Agricultural Meteorology, Volume 22,)

Evidently, working out similarly relations of precipitation with evaporation for the growing period and with minimum temperatures for the quiescent period, etc., may determine any climatic minimums of a crop. Of course, it is necessary to simultaneously consider ecological peculiarities of the plants being studied on the basis of all available information on this matter.

And so, considering all available materials on the climatic needs of crops and interpreting them under the climatic indexes enumerated above, utilizing a climatic analysis of the actual geographic boundaries, one may set up the following composite table.

(See next page for table.)

Thus one could put all plants in rising or descending order by their needs for level temperature, then by quantity of heat within this level, further by their temperature lows, and, finally, by their needs for moisture. It is to be regretted that this proposed classification has not yet been made.

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RESTRICTEDCLIMATIC MINIMUMS OF CROPS

<u>Crop</u>	Total of Optimum temperature tempera- (the relation of tures these optimums to over 10 climate is not en- degrees tirely clear, and Centi- they have only in- grade cidental importance)					Minimum moisture balance for the growing period	Remarks
	tempera- tures over 10 degrees Centi- grade	Optimum temperature (the relation of these optimums to climate is not en- tirely clear, and they have only in- cidental importance)	Tempera- tures which initiate growth	moisture balance for the growing period	Remarks		
Turnips used for root	1,000	15	5	1.2	Withstand		
Fiber linen	1,200	15	5	1.1	autumn and		
Summer Spring wheat	1,600	20	5	0.5	spring		
Oats	1,600	20	5	0.7	freeze-overs		
Sunflower seeds	2,200	--	10	0.5	up to -5		
Sugar beet	2,200	25	8	0.9	degrees C.		
Earliest corn	2,300	32	12	0.5	Susceptible		
Mid-season corn, Liming type	3,200	32	12	0.5	to freeze-		
Late corn, Khikori type	4,000	32	12	0.5	overs of		
Melons	2,400	--	12	---	lower than		
Early soy bean	2,500	--	10	0.7	-2 degrees		
Early rice	2,500	--	10	---	Centigrade.		
Earliest cotton	3,500	28	13	0.5			
Mid-season cotton	4,000	28	13	0.5			
Late cotton	5,000	28	13	0.5			
Gambo hemp	3,500	--	13	0.5			
Castor plant	3,500	--	10	0.5			
Luffa	4,000	--	15	1.0			
Early grape	2,800	30	10	0.3			
Late grape	3,500	30	10	0.3			
Fig	4,000	--	10	0.2	Withstand		
Laurel	---	--	10	0.2	frosts up		
Guayule	3,000	--	10	0.3	to -15 de-		
Tea	3,000	--	10	2.0	grees C.		
King orange	4,000	--	10	1.5	Withstands frost up to -8 degrees		

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RESTRICTED**THERMAL ZONES OF THE SOVIET UNION**

Setting as our problem the most economical utilization of available resources of heat and moisture and taking into consideration the actual distribution of these resources over the territory of the USSR, one must, above all, allot available crops by thermal zones corresponding to their needs for heat during the growing season.

Expressing the resources of active heat utilized by the majority of plants as the total of the 10 degree temperatures, one might divide the entire territory of the Soviet Union into 5 zones, beginning with the minimum amount of heat permitting agriculture, 1000^{Centigrade} degrees, the amount available on the northern border of agriculture. If 1000 degrees is conditionally considered the unit of heat permitting one harvest, then we can delimit (for the present, conditionally) five zones within the following totals of temperature: zone I, 1000-2000 degrees; zone II, 2000-3000 degrees; zone III, 3000-4000 degrees; zone IV, 4000-5000 degrees; zone V, more than 5000 degrees.

Thus, in the fifth zone the thermal potentialities seem to be five times greater than on the northern border of the first zone -- i.e., in the fifth zone one ought to be able to raise five crops for every one on the border of the first. But in practice this is not so -- in the first place, in the extreme south high temperatures and the short day hinder the development of plants which normally grow in the Far North, such as early root plants and the potato; in the second place, the energy of accumulation is proportional not only to the temperature of the air but to the quantity of solar radiation, which in the north decreases more slowly than the temperature, by virtue of the longer day of the north. However, with conditions of a more uniform distribution of temperature

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and length of the day during the year, five harvests of plants less exigent as to climate is possible (the turnip brassica rapa, the early potato). Experiments on the Black Sea littoral of the Caucasus, where the total amount of temperature higher than 10 degrees is 4300 degrees (Sochi), show that turnips seeded in September ripen in November, and seeded in March they ripen in June. The heat remaining for July and August is more than 1200 degrees, which is entirely sufficient for a third harvest -- but in practice the lack of moisture in the soil in these months with very high soil temperature (40 degrees Centigrade) and the exceptional activeness of insect pests makes a third harvest difficult. But a fourth winter harvest is impossible, because of the exceptional raininess of winter months and the extreme instability of temperature, although the turnip brassica rapa grows very well in the winter months (Selyanidov, "The Climatographic Basis of Agriculture on the Caucasian Black Sea Littoral," Proceedings of the Sochi Experimental Station, Volume VI). Noting that on the Black Sea littoral the total temperature above 10 degrees is a little more than 4000 degrees, the aforementioned data on turnip growing shows that our method of estimating thermal resources has a certain theoretical justification, but its conditionality is evident. As was pointed out above, it is necessary to consider the supply of sunlight in evaluating thermal conditions, since sunlight apparently changes heat (H. Lundegardh, "Clima und Boden in ihrer Wirkung auf Pflanzleben," 1925). Therefore any evaluation of heat supplies would theoretically be more correct not in terms of total daily temperature counted off at a meteorological observation point, but in terms of the total calories of solar heat measured by an actinometer, since the plant undoubtedly utilizes not only heat from the air but radiant heat from the sun and the entire universe. A computation

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of the quantity of solar heat in calories made by S. I. Savinov^y shows that supplies of this heat in the European part of the Soviet Union are not distributed longitudinally as are total temperatures, and that the difference between north and south in quantity of solar radiation for the summer growing season is less than in quantity of air heat -- i.e., heat measured by a thermometer at a meteorological observation point. The quantity of solar radiation in the extreme south of Central Asia is approximately three times greater than on the northern boundary of agriculture, while the total temperature is approximately five times greater. However, the effect of the activity of solar radiation on the rate of growth of plants is not quantitatively established, and the practical significance of the computation which we have cited is not clear.

Remembering the conditionality of the aforesaid division of the USSR into thermal zones, remembering also that areas of total temperature above 5000 degrees are extraordinarily limited in the Soviet Union, that for many crops the maximum total temperature has not been put into round numbers of thousands of degrees, that in addition to the total temperature it is necessary to also consider the yearly temperature course, particularly the winter temperature level (the winter growing season in Transcaucasia), remembering finally, our actual resources of plant species utilized in cultivation and species potentially important for agriculture, we ought to introduce certain changes in the zones we have outlined to make the following division.

Zone 1 -- Northern vegetable gardening or exclusively fodder raising, with total temperature from 100 to 1400 degrees, with cultivation of early root plants (turnips) and early potatoes. Grain cultivation is dependable.

Zone 2 -- Northern grain crops, with much development in cul-

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tivation of flax, potatoes, and fodder plants. Total temperature from 1400 to 2200 degrees. This zone with good agricultural techniques and sufficient fertilization provides the highest grain harvests (rye, wheat, oats, barley) and is the only zone valuable for flax and potato cultivation. It might be called the ^{Flax} ~~flax~~-potato-grain zone.

Zone 3 -- Corn, olive family plants, and in part sugar beets, together with winter wheat in the west to utilize the autumn and spring heat and for the most part durum wheat in the east. Total temperature 2200-3500 degrees. South of the isoline 2500-2600 degrees, large-scale ^{Cucurbits} cultivation of ~~melons~~, soy bean, and rice (the latter with a glaze); south of 2800 degrees, grapes. This might also be called the zone of southern cultivation, of particularly intensive fruit-growing. (In the northern parts of this zone, because of the small assortment of southern crops which ripen here and their small harvests, grain cereals still have a certain importance, as is shown on the agricultural-climatic chart).

Zone 4 -- With total temperature of more than 3500 degrees, suitable for cultivation of a number of valuable subtropic annual plants with a very long growing season, such as cotton, tobacco, the castor plant, ^{kanaf} ~~gmelina~~, the peanut, and luffa. Here cultivation of "early" vegetables and reaped crops is possible, to utilize spring and fall heat reserves. In this zone it is possible to cultivate late varieties of grapes which, south of the isoline of an average absolute yearly minimum of minus 15 degrees Centigrade, need no covering in the winter. This part of the 4th zone might be designated a wine subzone, or a subzone of June fruit-raising.

Zone 5 -- The subtropics proper, with total temperature greater than 4000 degrees (even greater than 3000 degrees), but with a winter

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growing season (winter vegetable raising) and with the possibility of cultivating subtropic perennials (fig, laurel, tea). The isoline of an average absolute minimum of minus 10 degrees is definitely the boundary for this zone. One ought to distinguish an "orange" subzone on the boundaries of this zone, with an average absolute yearly minimum no lower than minus 6 degrees (Sochi), where cultivation of subtropic plants more sensitive to frost is possible.

In the proposed allocation of crops by zones we have made our groupings according to the length of the growing season and needs of plants for a level of temperature, with the goal of utilizing the most possible of the growing season and most intensively utilizing its thermal resources. With this objective, we must move grain cereals of temperate lands significantly towards the north where the thermal optimum corresponds to their requirements. Grain cereals should remain in the south only as winter crops, utilizing fall and spring thermal resources unavailable to plants demanding more heat. We see such a combination of crops in North America, where winter wheat is cultivated in the corn zone. The presence of ^{spring} ~~summer~~ wheat in this zone in the eastern USSR justifies itself in the high value of the wheat grain received in these districts.

Devoting zone 4 up to its northern boundary to subtropic annual plants (cotton, peanut, ^{kenaf} ~~gambusia~~, etc.) is dictated by considerations of the people's economy, although yield of these crops with total temperatures of less than 4000 degrees is very small. Nonetheless, this zone even on its northern boundary has so long a growing season and such large heat resources that utilizing it only for southern plants (corn, soy bean, sunflower) is not rational. As regards suitability for cultivation of early, mid-season, and late varieties of subtropic annual plants,

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we must divide this zone into at least 3 subzones according to their quantity of heat. For the same reason that temperate climate cereal grains and grain flax must be moved northward to free southern zones for more valuable crops; we must move Central Asian rice. This crop, being entirely an irrigated crop and therefore independent of precipitation, ought to be moved from zone 4 into zone 3, where its early varieties are completely provided with heat, whereas in zone 4 it utilizes only 60-70 percent of available heat.

The distribution of thermal zones pointed out above, from north to south, is exactly repeated in mountainous areas from high altitudes down. The upper boundary of agriculture in the mountains approximately coincides with the boundaries of the forests, as it does in the north, and is concurrent with total temperature within 10 degrees of somewhat more than 1000 degrees. As we go lower, and the quantity of heat increases, first cereals are brought under cultivation, then fruit cultivation, corn, the sugar beet, grape, and finally cotton and subtropic crops. In general, the upper limits of all crops are determined by the quantity of heat, as it is in flat country. Every thermal zone in flat country has an analogous zone in the mountains.

ZONES BY MOISTURE CONTENT

The allocation of crops by zones which was noted above was based exclusively on an analysis of thermal conditions, but moisture conditions ought to bring a substantial change in this allocation.

We ought to state that unfortunately in the USSR thermal and hydrologic resources seem to be antagonistic -- as thermal potentialities increase hydrologic resources decrease, and where a maximum of heat is found moisture proves to be minimal. In this respect the climate of the USSR is very different from that of the USA, where thermal and hydrologic fea-

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of an average summer temperature of 21 degrees, where Chinese sugar cane squeezes it out. In conditions of the Soviet Union, one may speak of a southern thermal boundary for the beet in the North Caucasus, and also in Central Asia and the Trans-Caucasus, inasmuch as in general with irrigation beet cultivation will be economically important. In the North Caucasus the sugar beet should not appear below the foothills, but it may be seen on the plains there (Armavir and Belorechensk rayons).

This amount of moisture supply over 1.0 guarantees high harvests of corn and the soy bean, but an acceptable average harvest is received when the relation of moisture income and outgo is 0.7, which point should be considered the eastern and southern boundary for reliable cultivation of ~~summer~~^{spring} grains. The extreme southern boundary of agriculture may be taken as a relation between moisture income and outgo for the growing period of 0.5, as a climatic analysis of this boundary shows to be true over the whole world. To the south of this isoline, occasional successful sowings of drought-resistant varieties are possible, but the chance of success is small, and hardly justifies itself economically. Only millet may be raised here, with suitable soil, but this crop also is very risky.

Corn presents a somewhat different case. With all its drought-resistability, this crop cannot withstand hot, dry weather during its flowering period, since under these conditions fertilization of the feminine flower does not occur. And since in the steppe zone the danger of dry wind and generally of hot and dry weather increases in the second half of the year, the earlier varieties have more chance of successfully finishing flowering before the dry winds. But in the southern part of the steppe the probability of dry winds during the flowering period is so great that this crop loses its economic importance here.

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Unfortunately, to throw light on this matter cartographically is at present impossible, but we may estimate roughly that dependable corn cultivation cannot be carried on beyond the isoline of a May-July moisture balance of 0.7.

Vegetation maintains a steppe character when the moisture balance for May-July is as low as 0.3. Beneath this point, in the USSR, the land becomes wasteland.

It is necessary to mention that in the wasteland zone, thanks to the high winter temperature level and a better water supply in the spring months than in the summer, the so-called "bogara" agriculture becomes possible, in which sowing takes place in early spring or even in very late winter and harvesting before the onset of the summer drought. In Central Asia, such sowings are provided for where the relation of precipitation to evaporation for the growing months, in this case April-June, is not less than 0.5. But the success of bogara sowings is determined not only by the moisture supply during their growing period, but also by conditions of moisture accumulation until sowing, i.e., for the winter. On flat lands there is little winter precipitation, and this falls often in liquid form, but in the foothills and especially higher the snow covering acquires importance in accumulating moisture for sowing. Higher than 1000 meters above sea level, there fall more than 100 millimeters of precipitation in the form of snow.

Evidently a more expedient utilization of precipitation of the cold part of the year for ~~the same~~ ^{bogara agriculture} would be to sow in the fall. But unfortunately in the snowless winters of Central Asian plain winter crops only in Turkmenia are not frozen out, where winters are milder, or higher in the mountains, where the snow covering is more stable.

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Just as in southern zones with a moisture balance of less than 1.0 the lack of moisture is keenly felt and we may speak of the economic effectiveness of irrigation, so in northern zones there definitely is a surplus of moisture. What relation between moisture income and outgo should we consider surplus and harmful? According to the chart of Professor Atstsi, ("Le climat du ble dans le monde," 1928), the zone of surplus moisture for wheat is a relation of precipitation to evaporation, by the method of the author, of around 1.2. But Professor Atstsi's method is conditional, and actually a moisture surplus is definitely felt in the northwest European part of the Soviet Union, in the high mountain districts of the Caucasus, on the Black Sea littoral, in the high mountain part of the Urals and in the Far East, as is seen on the chart -- i.e., with a moisture balance of more than 1.3 and especially more than 1.5. In these districts the moisture surplus is as great an obstacle to cultivation as the lack of moisture in the south. All research on dependence of grain harvests on weather agree that the harvest in the northwest is directly proportional to temperature, and high temperature here always accompanies a small amount of precipitation -- but such conditions occur infrequently. In the north and northwest part of the Soviet Union the combination of the raininess of the warm part of the year and the melting of the deep snow covering so thoroughly soaks the soil that water remains for a long time on the surface of the land, and field work is prevented. This condition is maintained by the rather large quantity of spring precipitation (in May of more than 50 millimeters), which with a comparatively low temperature (a May temperature of 10-12 degrees) creates a moisture balance not conducive to the drying out of the soil.

A comparison of the average dates of oats and wheat sowing with

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the average temperature of the day of sowing (table 4) reveals that sowing is as a rule very much delayed, and only in the extreme southwest of the Ukraine and in the Crimea is Spring sowing done at a temperature near the initial growing temperature of summer grains -- 5 degrees. In a large part of the Soviet Union, sowing is done at a temperature from 7 to 10 degrees, and in the north even from 11-12 degrees. The delay is especially great in sowing in the Poles'e, where according to statistical data the average time of sowing is at a 13 degree temperature.

In these districts, because of the impossibility of sowing at the right time, around 30 days are on the average lost in the spring, which retards the ripening of the crop, leads to the necessity of utilizing earlier varieties, and in the end makes harvest lower. Drying and drainage ought to be very effective in these districts, if only because they considerably lengthen the growing season. A surplus of moisture is a hindrance during the whole growing season and is especially harmful in the period of ripening and harvesting. In addition, surplus moisture hinders the work of machines in the field and definitely hampers the mechanization of our farming, as experience with flax-harvesting machines has shown; finally, surplus moisture definitely worsens the thermal character of the soil, lowering the temperature of the upper layers of the soil and doubtless impoverishes the soil of nutritive materials (leaching), not to mention deterioration of the physical properties of the soil in general. So in the surplus moisture zone drying and drainage ought to be as effective as irrigation in the arid zone.

And so the entire Soviet Union ^{may} be divided into the following zones according to their hydrologic conditions:

- (1) Zone of surplus moisture, or zone of drainage; moisture balance of more than 1.3. The problem of drainage is especially critical

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in sections with a moisture balance of more than 1.5 (see map in addenda).

(2) Zone well provided with moisture, with a moisture balance of 1.3-1.0.

(3) Drought zone, with a definitely felt lack of moisture, zone of **bare fallows** ; moisture balance from 1.0 to 0.7.

(4) Zone of arid agriculture with unreliable harvests; moisture balance from 0.7 to 0.5. Irrigation also profitable for basic crops (lucerne, wheat). Agriculture in the subzone with a moisture balance of less than 0.6 (see agricultural-climatic map in addenda) is especially unreliable.

(5) Arid zone or zone of irrigation, with a moisture balance of less than 0.5 (semiwaste or waste land). Agriculture effective only with irrigation. ^{Boqara} sowings in early spring or in the cold part of the year.

To obtain a correct idea of the hydrologic peculiarities of different zones it is necessary to consider that from north to south not only the quantity of precipitation and evaporation change but also the very character of precipitation. In the first place, the frequency of rainfall sharply decreases in the south and west. While in the northwest there are more than 40 days of rain in the summer, in the south in the steppe belt there are only 20 such days, half as much, and in Central Asia less than 10 and even as few as 5.

Furthermore, while prolonged rains are a rare occurrence in the south, in the north they are the rule, and such rains are especially harmful in field work and, in particular, make combatting weeds difficult. In the subtropic zone there are no prolonged rains at all during the summer, while in the cold half of the year here there are prolonged rains almost exclusively.

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The same change in raininess which is seen from south to north occurs in vertical zones from lower altitudes to higher -- the higher up in the mountains, the more frequent and prolonged are rains.

Table 6

UNUTILIZED SPRING HEAT

Station (arranged north to south)	Sowing temperature	OATS		Number of days between a and b
		a: Date of Sowing	b: Date of 5 degree temperature	
Vologda	11.3	22 May	26 April	26
Novgorod	11.5	19 May	23 April	26
Perm'	11.3	23 May	27 April	26
Uspenskaya	11.1	15 May	24 April	21
Moscow	10.9	9 May	21 April	18
Kazan'	11.6	9 May	21 April	18
Belebeevskaya	8.4	4 May	24 April	10
Shatilovo	9.1	3 May	20 April	13
Khar'kov	7.5	17 April	8 April	9
Kamyshin	11.8	2 May	10 April	22
Stalingrad	10.8	25 April	7 April	18
Uman'	5.5	10 April	8 April	2
Ploti	4.9	31 March	1 April	- 1
Yeysk	8.3	12 April	31 March	12
Krasnodar	8.7	5 April	17 March	19

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Station (arranged north to south)	Sowing temperature	SUMMER WHEAT		Number of days Between a and b
		a: Date of Sowing	b: Date of 5 degree temperature	
Kirillov	7.0	8 May	30 April	8
Perm'	10.0	15 May	27 April	18
Savali	10.6	11 May	23 April	18
Belebeevskaya	8.5	5 May	24 April	11
Tomashov Kolok	8.0	27 April	19 April	8
Tambov	9.8	2 May	16 April	16
Bezenchuk	9.0	29 April	19 April	10
Voronezh	8.7	25 April	13 April	12
Balashov	10.5	3 May	15 April	18
Ural'sk	10.7	30 April	17 April	13
Kamyshin	10.3	27 April	10 April	17
Stalingrad	12.5	30 April	7 April	23
Ploti	4.4	28 March	1 April	- 4
Rostov-on-the-Don	8.2	12 April	31 March	12
Obitochenskaya	5.8	8 April	4 April	4
Yeysk	8.3	12 April	31 March	12
Stavropol'	6.0	13 April	8 April	5

DETAILS OF ZONING

All the material cited above definitely indicates that the basis of a natural-historic division of the Soviet Union must be a zonal distribution of crops. The agricultural content of climatic zones is so similar over the entire Soviet Union, from the western boundary to the Pacific Ocean, that any other division is evidently impossible.

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This strongly zonal distribution of crops is distinctly repeated in the mountain districts, but vertically. Here one meets all the same agricultural-climatic zones and in completely the same order. The difference is in the fact that certain zones are absent, due to the aridity of the climate. For example, there is no fiber flax in Central Asia and the Malyy Kavkaz, and for the same reason the sugar beet zone has only an intermittent extension here. Actually, the reasons for the absence of fiber flax and the sugar beet in mountainous districts are of a historic and economic order, and, so far as soil conditions permit, these crops are entirely possible within certain altitudes.

Recognizing the basic zonal quality of agriculture, it is necessary to point out that within the indicated zones climatic conditions noticeably vary. This heterogeneity of climate manifests itself: (1) in differences in the yearly amplitude of temperature -- i.e., in the steepness of its rise and fall; (2) in the degree of stability of temperature; (3) in wintering conditions; and (4) in the yearly course of precipitation, its stability and its character.

This fluctuation in climatic conditions over the expanses of the Soviet Union is so great that it cannot be without influence on cultivation. It is especially necessary to notice the influence of our continental climate on farming conditions in each zone. The continental qualities of our climate are important so far as they reduce the period of spring and fall sowing, shorten the growing season, and, particularly, the frostless season, raise maximum temperatures in the summer, increase the daily temperature fluctuation, worsen wintering conditions, and strengthen the changeableness of precipitation from year to year. Since all these manifestations of the continental quality of our climate are closely interlinked, it is sufficient, as a first approxi-

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mation, to estimate the degree of continentalness by the rapidity of the increase in spring temperature (see map in addenda). This estimate can be expediently made by a calculation of the number of days from the advent of a 5 degree temperature, i.e., the beginning of sowing, until the advent of a constant 15 degree temperature, i.e., the end of sowing. As is seen on the appended map, this sowing period in the northwest lasts 60 days, in Central Asia and Yakutiya 30 days. How this difference is practically important is evident.

As regards wintering conditions, the worsening of these conditions in the east because of the decreased snow covering and increased frosts imposes a boundary on the distribution of winter crops in the east, of perennial crops in general (clover, lucerne), and particularly of fruit-growing. The appearance of perpetually frozen ground makes this geographical limitation even more pronounced.

On the appended map is given the distribution of absolute yearly temperature minimums on the territory of the Soviet Union, as indications of the harshness of wintering conditions. We may assume that harshness of wintering conditions considerably worsens from west to east with the following natural boundaries: (1) the Donetz ridge and the margin of the Central-Russian highlands; (2) the Volga and the Yergeni hills; (3) the Ural and Mugodzhar ranges; (4) Altay and the Yenisey River; (5) Lake Baykal; and (6) the Stanovoy range.

By the first boundary conditions for cultivation of winter wheat have already sharply deteriorated, by the second the possibility of cultivating this crop are almost nil, by the third the eastward extent of fruit-growing and perennial grasses (clover, European lucerne) is limited, the fourth restricts the cultivation of winter rye, the fifth excludes winter rye cultivation at least until we reach ^{the} Amur. The situation becomes

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better by the Ussuriysk Kray.

Thus, one may divide the chief agricultural-climatic zones of the Soviet Union into five or six sections or regions which contain different perennial crops. We also ought to divide off Central Asia, where, as is pointed out above, winter wheat is frozen out on the flatlands.

As wintering conditions worsen towards the east, the growing season also becomes shorter. With the same quantity of heat within 10 degrees the length of the growing season within those points changes in the following manner:

Table 7

	LENGTH OF GROWING SEASON WITH THE SAME AMOUNT OF TEMPERATURE					
	Western	Eastern				
	European	European	Western	Eastern		Far
	<u>Part, USSR</u>	<u>Part, USSR</u>	<u>Siberia</u>	<u>Siberia</u>	<u>Yakutia</u>	<u>East</u>
Total temperature 1600 degrees (on the northern boundary of wheat)	113	110	106	103	97	105
Total temperature 2200 degrees (on the northern boundary of corn)	145	130	134	---	--	133

Nonetheless, calculating temperature from 0 degrees, as is usually done, somewhat artificially increases the amount of temperature in its slow westward rise; if we calculate from 10 degrees the differences between west and east are levelled out, revealing that in circumstances of a sharply continental climate thermal conditions for ~~summer~~ ^{spring} grains do not worsen so strongly.

Particularly in Yakutiya and in general east from the Yenisey to the Stanovoy range and Khingan, summer crops and especially summer wheat

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give unexpectedly good results. In all these regions there peculiarly unites an average low summer temperatures level with a comparatively high temperature in the hottest month (July temperature of 19 degrees in Yakutsk, which characterizes the Tula district), and in addition the summer months are arid and with comparatively little cloudiness. Such a conjunction of climatic condition is seen elsewhere only in certain parts of western Canada, and in the end provides for wheat ripening in conditions of a very small amount of air heat, evidently on account of direct solar radiation. Wheat ripens here with total temperatures of 1400 degrees, though, it is true, with the particular local varieties having a small yield and small grain. The climatic conditions peculiar to Yakutiya are a small moisture supply and a sharp rise in temperature. These exclude the possibility of fiber flax cultivation, but are entirely favorable for early potato and root plant cultivation.

No less original climatic conditions are found beyond the Stanovoy ridge and Khingan, in the Far East. Here the so-called monsoon weather is felt, which is characterized not only by arid winters and rainy summers, which in general are particular to continental countries, but also by the stability, regularity, and abundance of the summer rains. In amount of summer rains, the Far East has competition only in the southern part of the Black Sea littoral of the Caucasus. 120 millimeters of precipitation in the hottest month, an amount frequent in the Far East, ~~is~~ seen nowhere else in the flatland part of the Soviet Union, where the average amount of precipitation in the rainiest month is always less than 100 millimeters. If we consider that a moisture balance of 1.3 delimits surplus moisture, in Khabarovsk with a yearly total of 564 millimeters -- 25 percent of the yearly total -- while in Smolensk with the same yearly total of precipitation but a lower level of temperature,

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surplus moisture in the hottest months is 10 percent of the yearly total.

Comparison of grain harvests with weather conditions in the Far East reveals that years of poor harvest are those with a large amount of precipitation at the end of the summer. In addition, a large amount of rain combines with relatively high temperature of the hottest month, for example, in the steppe belt of the European part of the Soviet Union, promote an exceptional development of fungus blights, which in the end lower the grain harvest in the Far East. Therefore, drying and drainage are currently nowhere so important as in the Far East.

We may consider a characteristic^c peculiar to the Far Eastern area to be the relative aridity of the spring, compar^g after an almost snowless winter, features which allow sowing as early as temperatures permit, insofar as soil moisture is sufficient for this work. The autumn here is also relatively dry, so harvesting conditions for late crops are unfavorable. But in general climatic conditions in the Far East are considerably worse for agriculture than those districts in the European part of the Soviet Union (the North Caucasus) corresponding to them in latitude. The unusually harsh snowless winter (January temperature in Khabarovsk of minus 22.9 degrees); the short growing season with frosts late in the season, and the excessive raininess of the summer with a comparatively low level of temperature in the summer months (July temperature in Khabarovsk of 20.7 degrees, in Nikol'sk-Ussuriysk 21.4 degrees) excludes all possibility of comparing the Ussuriysk Kray with the subtropic zone of the USSR and even with^{the} Kuban' (July temperature in Krasnodar of 23.6 degrees).

In the Western Trans-Caucasus is seen the best combination of heat and moisture in the whole Soviet Union. The amount of heat there is considerably less than in the extreme south of Central Asia, approxi-

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mately 20 percent, but a large amount of precipitation makes possible the maximum utilization of all available heat resources, without resorting to artificial irrigation. Finally, the unusually warm winter in the Western Trans-Caucasus permits us to carry on cultivation the year round without interruption (winter vegetable raising), which is possible only in the south of the Lenkoran uyezd in ³Azerbaydzhan, in the Apsheron Peninsula and in the Zakopetdagskiy Rayon. However, in Lenkoran the summer months are very dry, and cultivation the year round is difficult without irrigation. On the Apsheron Peninsula the summer is completely rainless and only the cold months are comparatively well provided with precipitation. In the Zakopetdagskiy Rayon irrigation is also essential.

As for the rest of the Western Trans-Caucasus, in those parts not valleys and not riverain lowlands (Mugan Steppe, etc.) approximately up to 300 meters above sea level -- i.e., in the foot hills -- there is some possibility of cultivating the most frost-resistant subtropic perennials -- for example, the fig, the olive, the laurel, certain bamboos, guayules, and persimmons. But because of the aridity of the climate only drought-resistant perennial plants may be cultivated here without irrigation. The low level of winter temperature (January temperature below plus 2 degrees) everywhere, except in the littoral belt, and frequently repeated freeze-overs give no prospects of winter vegetable raising here. This is the situation, for example, in the Zakopetdagskiy rayon in Central Asia.

It is necessary to conclude with features of a non-climatic order, leading to this or that readjustment in our estimation of the climatic possibilities of the land.

Soil features bring about very great differences in the agricultural potentialities of every zone. Here we must notice above all the difference

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in physical properties of the soil (sandy and clayey) and the influence of topography (exposed positions and valley positions). These features could bring real readjustment in our estimation of agricultural potentialities, but unfortunately it is difficult at present to qualitatively account for them. These features ought to be considered before all others when zones are divided into districts (P. Koloskov, Climatic Basis of Agriculture in the Amur Oblast.) At present we may consider it established only that in the subtropic zone and in the Far East valleys greatly lower the agricultural possibilities of the zone, seeming to show an impenetration into the zone of characteristics of the more northern zones.

We may put aside a consideration of soil fertility, since this feature may be controlled by man, as well as of the extent of insect pests, inasmuch as the latter is not determined by climate. Thus, for example, the wide extent of the Swedish fly in the Central Black Earth Area and neighboring places is evidently no hindrance to the conquest of this district by summer wheat, since the Swedish fly appears accidentally in these districts and ought to be eliminated.

A more insuperable obstacle to the realization of agricultural potentialities[†] afforded by the climate is the swampiness, saltiness, and primitiveness of soils, which at present keeps a huge land area from cultivation. Western Siberia and Kazakhstan suffer especially in this respect. But here, evidently, only the primitiveness of the soil is a completely insurmountable obstacle -- saltiness and especially swampiness may be conquered by technology. Therefore, the appended map on the specialization of cultivation for many districts shows projects not only for the First Five-Year Plan but for later plans. Doubtless the practical realization of the proposed zoning will depend on the introduction of socialist types of production, the development of techniques and material

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resources of our land, but this zoning is completely practicable in its climatic bases and needs only more precise working out of details. This latter depends greatly on the development of a general climatological study, which, one must say, is extremely retarded. This backwardness of general climatology, the absence of a summary for our entire land of the chief elements of climate and especially of practicable climatologic maps hinders an agricultural evaluation of climate.

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ADDENDA:

1. Map of agricultural-climatic zones of the USSR. Prepared by Selyaninov.
2. Map of the length of the period from 13 degrees in the spring to 12 degrees in the fall -- growing season of corn, cotton, soya. Prepared by Gedeonov.
3. Map of the length of the average frostless period. Prepared by Gol'tsberg.
4. Map of spring isochrones of 15 degree temperature, establishing the time in which it is possible to begin sowing corn, soya, cotton, and other plants exigent as to heat.
5. Map of the continentalness of climate. Prepared by Gedeonov.
6. Map of climatic conditions of wintering of perennial plants. Prepared by Naryshkina and Gol'tsberg.
7. Map of isotherms for January and July.
8. Map of total precipitation for May, June, and July, the main growing period. Prepared by Gol'tsberg.

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LAND RESOURCES FOR PLANT CULTIVATION IN THE
USSR AS REGARDS THE GEOGRAPHY OF SOILS

L. I. Prasolov

INTRODUCTION

In dealing with the distribution of the sowing area of food and industrial crops and their allocation by zones and districts, first of all we face the problem of the very unequal distribution of land already under cultivation and the relative limitedness of the supply of suitable lands on the wide territory of the Soviet Union. The entire sowing area, the different crops as well as wild vegetation, ^{are} ~~is~~ dependent on the zonal differences of climate and soil. Soils are closely linked with climate, but reflect also the influence of other natural conditions: geologic structure, surface topography, surface and subsurface water, the plant and animal world, and also human activity.

The geography of natural soils, which has been worked out, in comparative detail, may serve as a general indication of the capacity of the land for cultivation. We may be sure, judging from many existant instances, that the extent of agriculture is strongly dependent on soil.

We would like to state conclusions in this work on land resources of the Soviet Union which we have derived from an analysis of soil geography of the entire Soviet Union, an analysis based on our most newly collated soil maps.

I. A SHORT STATEMENT ON MATERIALS AND METHODS

In the last five or six years soil cartography has made great advances in the USSR. Expeditions for gathering material on soil have penetrated all our most distant areas -- the Far North, Kamchatka,

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Central Asia, the Trans-Caucasus -- and in addition have added significantly to the detail of soil surveys of our agricultural districts. This work was done on such a large scale that, for example in Wheat Trust research of 1929-30, certain new material could not be fully utilized and its theoretical significance determined -- this should be the task of the next few years. Over a 50 year period (from the time of Dokuchaev's first work) geographic soil research has been carried on to the following extent (in round numbers):

1. Complete area soil mapping on a scale of
from 1:25,000 to 1:420,000 . . . 3,000,000 square kilometers
 2. Surveying on foot 5,000,000 square kilometers
 3. Aerial reconnaissance 13,380,000 square kilometers
- Total 21,380,000 square kilometers

All this material (which does not include the detailed surveying which has taken place in the last two years) was gathered and worked out by Soviet soil scientists at the Institute of Soil ~~imeni~~ Dokuchaev and published in two maps: the Asiatic part of the USSR, on a scale of 1:4,200,000 (1926), and the European part of the USSR, on a scale of 1:2,520,000 (1930). (In 1931-32, a new compilation is planned on a scale of 1:1,000,000.)

After the publication of these maps, to facilitate their practical application, an estimate of the area of different soils was made, by two-degree latitudinal belts and by chief administrative districts. (This work was done by the Dokuchaev Soil Institute and the Institute of Soil Management of the Lenin Academy.) The urgency

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of the need for this work prohibited our making certain adjustments in this estimate -- which, however, does not change the main conclusions of the work.

This estimate was made by the method developed and applied by Shokal'skiy and Tillo for estimating river basins (A. A. Tillo and Yu. M. Shokal'skiy, "An Estimate of the Highlands of Asiatic Russia, from the Evidence of the Areas of Basins -- Oceans, Seas, Rivers, and Lakes, as well as of Administrative Subdivisions, St. Petersburg, 1905) by measuring (with the aid of a planimeter or a transparent sheet divided into squares of one millimeter) in one or two degree trapezia sketched on maps longitudinally and latitudinally, individual contours the area of which is known. The exactness of this estimate was usually within 1 percent (except for especially complex contours), which for this scale and in terms of what soil maps are supposed to show, is entirely sufficient.

In this way, we have obtained relatively exact measurements of the distribution of the chief types and varieties of soil over the entire territory of the Soviet Union (a total of approximately 50 subdivisions).

An analysis of these measurements comparing them with a given agricultural and economic geography, beyond doubt can lead to many interesting and important conclusions. We apply here the results of our calculations chiefly for an estimate of land resources.

In this connection it should be stipulated first of all that these results are somewhat tentative and there are limits to the practical application of soil cartography and the calculations derived from it. Nature, in all the complexity of its phenomena, does not permit us to consider quantitatively all the properties of soil

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and depict them on maps. A record of individual characteristics, however, such as for example potassium or phosphorus content is very interesting in itself, yet this cannot give us an understanding of soil, as a whole natural substance with a dynamic interrelationship of physical, chemical, and biological properties. Therefore, the study of soils combines observations and properties of soils taken as a whole in genetic groups, giving a break-down and types. This is the basis for soil cartography, which at present reflects only in summary form the many different properties of soils within our present knowledge and observation. Only by making use of such summary analysis is it possible to map out the soils of large land areas. Accordingly, we should not reproach soil geographers. We should not confuse genetic types of soil, as concepts, with a complete and true representation of soil masses, which in fact are very changeable in time and space. Genetic types of soil must be observed in the field, considering every case separately.

It goes without saying that soil types in themselves and summarily, reflect the agricultural characteristics of the area where they are typical or predominant. But it is clear that the agricultural qualities and the yields of individual fields located within the limits of this territory can be extremely diverse and cannot be directly multiplied by the size of the territory, because soil strata are generally quite jumbled, and because of the arbitrariness of subdividing soils into categories. Most of such categories are not sharply-defined also as a result of the fact that the quality of soil changes greatly from cultivation and the application of fertilizers.

In addition, the complicated interrelationship of soil and plant prohibits any numerical summarizing of characteristics of different

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soils which would indicate their agricultural worth. Earlier attempts of this sort (scales of soil evaluation) must be recognized as unsatisfactory. Agricultural chemistry and agricultural physics are experimenting with and applying various methods, often very complicated and expensive ones, but at best they express only individual properties of the soil. Moreover, a consideration of geographic implications of these agricultural factors which would make it possible to apply the conclusions to a large area, is at present something still in a rudimentary stage. Therefore, we are not able at present to interpret the size of the soil area into a numerical expression relative to its agricultural importance. This is a problem for the future, perhaps not far from solution -- but at present we can make use only of geographic comparisons of soils, land, and crops.

There follows below a general survey of soil geography by zones, which is one basis of the geographic structure of the territory of the Soviet Union -- the structure as related to agricultural lands, taking into consideration that industry may influence the distribution of crops. This short survey serves as a commentary on the appended basic tables, an analysis of which may form the subject of the concluding chapters, including possible general conclusions on the distribution and composition of the land resources of the Soviet Union.

It is entirely clear that this work may not pretend to be an exhaustive exposition of the subject. It was drawn up in haste and is limited in size. A fuller survey of soil geography of the Soviet Union and the primary data for this survey are being prepared separately.

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II. SOIL ZONES, THEIR AREA, AND THEIR DISTRIBUTION OF LAND RESOURCES

1. Tundra

In the Far North along the banks of the Arctic Sea stretches the wide belt of the tundra, i.e., the forestless expanses, or arid or marshy land with soil frozen a large part of the year and melted in the summer though not very deeply and only for a short time. Here there is the cold polar climate, comparatively arid -- i.e., with an amount of precipitation totalling approximately 200 millimeters per year. The tundra belt stretches for hundreds of kilometers to the south of the Arctic Ocean and occupies on the whole 2,345,600 square kilometers on the territory of the Soviet Union, not considering the belts of transition to the forest zone, the so-called forest-tundra zone. The area of the latter in Siberia is 746,300 square kilometers and in the European part no less than 100,000 square kilometers. Located in an area of severe climate, the landscape near the polar tundra greatly resembles the forestless mountain tops, in Siberia called "gol'tsy;" these are to be found in Siberia and also in the northern Urals and on the Kola Peninsula covering an overall area of around 290,000 square kilometers.

Soils on the tundra are similar to soils of the northern forest zone, the podsol type and swampy forest soils. But they are far from identical over the entire huge expanse of this zone. Here one finds more suitable fodder lands for reindeer (known on the Yakutsk tundra as "yedomy") and unsuitable lands -- stony, saline, marshy, and so on.

Differences in soil are conditioned on the one hand by the geologic structure, for example by outcroppings and the composition of

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alluvium (arenaceous or argillaceous) and on the other hand, by the properties of the surface itself -- now even, now undulating, etc. The distribution of snow in the winter and of soil water in the summer, is effected by the surface of the land, and also by the depth to which the ground thaws. Where low and even areas predominate, where the soil does not thaw out to any great depth during the summer (approximately 30-50 centimeters), and where there is not much evaporation of moisture with the low air temperature, here most of the tundra is saturated with moisture down to a small depth in the summer-time. Because of this, air does not penetrate the soil very well (insufficient aeration) and deoxidation takes place as in marshy soils. This condition, together with the action of the cold polar climate in general results in a weak development of chemical and biological processes in the soil. On the other hand, poor absorption of water on the arid tundra, strong winds, and soil cracking from frost have led to extensive erosion and weathering of the surface. Not infrequently this also has accentuated surface slipping and heaving caused by the unequal expansion and contraction of soils during melting and freezing.

Therefore the tundra is frequently characterized by spotty areas ("the bald tundra") with circles of a bare argillaceous detrital nature. Hillocks and mounds of peaty marshy soils are also very widespread. A considerable belt consists, finally, of low shoals on the banks of the Arctic Ocean, some washed with its waters, others dry, grown over with saltworts, some bare, for the most part moist, and in the summer-time almost impassible.

But all these varieties of tundra are not differentiated on our maps, and therefore the area of this zone is not subdivided in our tables.

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In this title is included all the huge belt of northern forests which occupies more than half of the territory of the Soviet Union, around 11 million square kilometers, stretching towards the south from the tundra of high latitude, reaching as far as the south in Eastern Siberia as the southern border of the USSR.

As is known, this zone also extends into Western Europe, but is of considerably smaller dimensions from north to south, although there are very clearly defined podsoles in America, where they occupy a large part of the British dominions, and extend into the northeastern part of the United States.

Podsol and podsollic soils are the only characteristic and the most widespread kind of soil of this zone but not the only one.

Together with the podsol, marshy and semi-marshy soils are very widespread here (and in places are even prevalent); humus-carbonaceous soils (the so-called rendziny), and meadow and alluvial soils are also very common, though they do not occupy such a large area. The Russian popular name "podsol," at present accepted also in agricultural literature abroad, is now applied only to the most extreme stage of a special soil formation process in dense forests, chiefly of northern coniferous varieties.

The soils of these forests, and the fields located among them, which were once also thickly covered with forests, represent really a patchwork of a complex and motley combination of different varieties of podsollic soils together with marshy and semi-marshy soils. Investigation into all zones of the podsol, especially its northern almost uninhabited half, is still not sufficiently advanced so as to make a clear exposition of the origin of these combinations, their

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breakdown in all districts, their changes, and their agricultural importance. For around 50 years they have been studied from various aspects both here and in Western Europe. In individual cases in experimental stations and (partly with forestation as the objective) the chemical and physical properties of podsol soils have been studied in detail, with particular emphasis recently on the occurrence of acidity and the means of eliminating it.

Here we may give only a very short and general sketch of these soils, isolating their basic varieties, and thus try to break down all this huge zone into its chief geographic components.

As is known, forest podsol soils when brought under cultivation are quickly exhausted and demand manure and mineral fertilizer. They are comparatively poor in nourishing substances, and in their natural condition possess unfavorable physical properties -- they easily dissolve in moist periods and contract when they dry out, which renders difficult the necessary aeration of the soil. The upper layers of the soil contain little humus and few argillaceous particles, their powers of absorption are insufficient, and the soil base (acid soils) is not impregnated, so the nutritional substances gradually leach away and are carried off by the flow of the soil moisture.

All these properties are the more strongly felt the more the soil is reduced to podsol under summer conditions -- i.e., the more its original mineral mass is decomposed by the constantly descending flow of soil moisture containing products of the decomposition of the forest floor in the form of carbonic acid and other soluble acids of the humus. The visible result of this decomposition of the mineral mass is the accumulation in the soil of finely broken up quartz powder,

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as a residue of the disintegration of fragments originally of rocks and minerals, owing to which the soil under the upper humus layer is bleached, becoming sometimes completely white, loses its binding argillaceous particles, and becomes a dust-like mass similar to ashes. At the same time, the lower layers of the soil, where the argillaceous and other products of erosion are held, become thicker and more water resistant, hindering penetration of water to the deeper roots.

All these phenomena vary greatly, chiefly because of the distribution of surface moisture, which depends upon surface topography and the character of the surface vegetation. Together with podsol, which is the most advanced stage of this process, strongly-, average-, and weakly-podsolic soils may be distinguished. How essential the difference between them is in practice may be judged from the fact that podsoles and strongly-podsolic non-arable soils need around 18 tons of lime per hectare, while weakly-podsolic soils need 3-4 tons or less. (Experiments under the direction of K. K. Gedroyts in the former Soil Management Division of the GIOA, 1926-27.)

Unfortunately, here we come up against the lack of research into podsollic and generally northern soils, precisely in regard to a quantitative expression for the degree of podsollic development, concerning a clear understanding of such development relative to soil acidity and how this related to the content of nutritive substances. The degree of podsollic development of soils, clear enough by externals (by their morphology), has still not been linked up with their chemism or their origin, as a result of which their general geographic distribution is far from clarified.

Therefore on our general maps we could not chart boundaries of the different degrees of podsollic soils. These are given at present only on certain more detailed maps of okrugs and rayons. In addition,

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the difference between podsollic soils still does not exhaust the aforementioned degrees. No less complex and, in addition, important for agriculture and forestry are differences in mechanical composition, also in chemical composition of the mineral mass of these soils, and in a number of other compositions and features. One may say that every soil feature, be it the thickness of the separate layers, their form, composition, transitions from one stage of these to another, and finally the whole structure (the entire cross section) of soil taken en masse in nature has various differences and combinations which identify in one way or another, the soil properties. Cultivation partly evens out these differences, partly complicates them, since cultivated podsollic soil is quite different from virgin soil -- it loses the upper layer of forest floor, the podsollic soil becomes mixed with the humus layer, its acidity for the most part decreases, and microbiologic activity increases. Plowing in itself changes the topography of the soil surface (which is especially noticeable on the small strips of the peasant fields).

We cannot consider geographically all these changes, and, generally, we do not even have maps of the extent of cultivation of forest soils. We can judge how widespread they are only from the location of inhabited places. Therefore, on our general maps we may divide soils only into the three chief types of mechanical composition: argillaceous-loamy (heavy and average), arenaceous-loamy, and arenaceous. Gravelly types are shown separately.

On maps and on the basic tables it is evident that on our Eastern European and Western Siberian plains argillaceous and argillaceous-loamy types are equally widely distributed, insofar as may be determined at present from information far from complete. Arenaceous soils are considerably less widely distributed, their

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area covering 386,000 square kilometers in all (we do not include here, of course, arenaceous areas in the southern desert zone).

In hilly and mountainous districts we customarily see a very frequent change in the mechanical composition of soils, leading to a widespread development of "skeletal" soils, i.e., soils rich in gravel. This is far from always an indicator of poor ploughing -- on the contrary, in northern districts such changed soil sometimes is preferred because it warms up more quickly and is dryer. Arenaceous-loamy and arenaceous soils, in general, are principally formed from alluvia, more or less sorted out in the water currents or basins which deposited them. Therefore, we find them widely developed on the plains of our European north and in Western Siberia, whereas in Eastern Siberia, where soils are formed primarily on mountain slopes and heights on top of the products of the destruction of the original dense rocks, we find clayey soils more or less abounding with large fragments of these rocks.

As regards this, we note that in Eastern Siberia one often sees soils among the podsollic soils which are not very podsollic and in addition are of weak potency, whereas on the plains of Western Siberia and a part of the European north there are many deep podsols.

Many researchers point out also that in the northern half of the forest zone under the influence of a harsher climate the process of evolution towards podsols seems to have died out and has usually become an evolution towards marsh conditions. The approximate boundaries of these subzones, their main areas, are indicated on the map of the Asiatic part of the USSR. In the European USSR the northern "dwarf podsol" is seen on the Kola Peninsula.

Sandiness is an indication of the richness of the soil and

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also of its technical properties for cultivation.

Heavy soils (argillaceous-loamy and argillaceous soils) are for the most part considerably richer, but frequently have unfavorable physical characteristics -- they may be too heavy for cultivation, hold too much moisture, and may be warmed up and aerated only with difficulty. Therefore argillaceous loamy soils are for the most part preferred, especially for certain crops (for example, potatoes).

In the north, in addition to the soils absolute richness -- determined by its chemical make-up (independent of its mechanical make-up and of the degree of podsol development) and the amount of fertilizer applied -- its physical make-up is also important. This determines the use of the soil itself, determining particularly whether vegetation will obtain its required maximum warmth and elimination of moisture surplus. So naturally in evaluating the agricultural quality of this or that district all factors are especially important which bear upon the supply of warmth (rolling hills, southern slopes, etc.) and, so also, the removal of the surplus moisture is very important.

Swampy surplus-moisture soils occupy a very large part of our northern zone. They are not yet being studied in sufficient detail. Large sections of the forests and meadows here are swampy, with the so-called podsol gley soil or peaty podsol soil. In their natural surroundings under a dense forest cover, very often too much decomposing vegetation accumulates and bryophyta grow up, which retards or completely cuts off the oxygen supply to the minerals of the soil under the floor of ^{humus} ~~humus~~ and bryophyta, as the result of this, anaerobic microbiologic processes begin, the soil deoxidizes, and oxide compounds are formed and even products of certain completely reconstructed compounds (for example, sulfurous compounds).

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These compounds by themselves for the most part are toxic to plants, and the deoxidized soil, supersaturated with moisture, becomes for the most part "gley soil," impermeable blueish clay,

With the further growth of bryophyta, such soils gradually become peaty swamps on which the forest dies out. But peaty swamps have also been formed and are at present being formed in another way, by aqueous vegetation and then bryophyta which grows over lakes and stopped-up rivers. Thus, highly developed peat bogs are formed, grown over in the final stages with white bryophyta (Sphagnum species), and as deep as 5-10 or more meters. Sometimes their formation stops at a stage of herbaceous vegetation (reeds, sedges, etc.), or a forest or meadow soil is for different reasons transformed into a herbaceous swamp.

By virtue of the dynamic quality of all these phenomena, soils of the northern zone represent, as has been said, a detailed complex which it is not easy to analyze, the more so because all these places are accessible only with difficulty and often they are almost inaccessible. Swamps and transitional semi-swamps show on more detailed maps very intricate configurations.

It is quite understandable that at present the peat marshes which we have studied and mapped are those which are being exploited in our industrial districts, being one of our most important power resources. But we do not have even approximate information concerning the huge expanses of marshy forests in the north, especially in Siberia. Especially rich in swamps is the lower Ob' River basin, for example, the basin of the Vasyugan' River. Evidently Eastern Siberia is less swampy, but here the swamps form water-resistant layers, allowing a large area to be perpetually frozen over. In

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Yakutiya, in the Transbaykal region, and in the Far East, unique thickets of marshy brushwood (of birch and willow species) are widespread, the so-called "yerniki." Not infrequently they occupy up to 50 percent of the total land area, located in the wide flat ravines of the mountain slopes. Their semi-swampy soils, somewhat peaty and gleyey, are still very little studied.

The further one goes towards the north, the larger an area is taken up by swampy soils, and in the forest-tundra belt they predominate. But it is unknown exactly how much of this area is really peat bog.

On our maps we could not give the contours of swampy and semi-swampy soils, because these are not measured; but we have indicated them everywhere, where there is information concerning them. In addition to the map of the European part of the USSR, a small map of the swamps of the Leningrad Oblast is printed in black (with the exception of the Murmansk Kray), drawn with all possible completeness according to a detailed topographical map. It shows how many swamps there are in this district and how difficult it is to represent them and allow for them on general maps.

Swamps, and also peat bogs and mossy and semi-swampy soils, are conditionally unsuitable areas, since, apart from utilizing their power resources in the form of peat, they may be transformed into good forest, meadow, and arable lands. Certain species of low-land swamps represent especially favorable soils rich in nourishing elements.

According to data of the onetime Central Statistical Committee, in 1887 on all Russian territory there were 3,736,640 square kilometers of marshy lands; in this calculation tundra marshes were evidently

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included. According to data of the Institute of Agricultural Reclamation, in the RSFSR there are 351,670 square kilometers of marsh lands (not including tundra marsh lands). According to Vikhlyaev, the general area of swamps in the USSR is 373,000 square kilometers, in which, probably, are counted only the real peat marshes, more or less valuable for peat extraction.

The amount of marshy woodland, meadows, and different species of semi-marshy soils, as is evident from the aforesaid, is very great. We may consider that the general amount of marshy land in the northern zone is close to 1,500,000 square kilometers (not counting the tundra).

As was mentioned, among the swamp and podsolic soils there are not infrequently humus-carbonaceous soils (rendziny) and meadow and alluvial soils; these are often almost the most valuable part of the land in agricultural productivity.

Humus-carbonaceous soils are formed where there are outcroppings of limestone, marl, and gypsum, or affluvia containing a large quantity of liming fragments (carbonaceous moraine), because of which the podsol formative process is held up, and a dark soil is obtained, richer in humus and devoid of acidity (natural liming), similar to the steppe chernozem or black soil.

Meadow soils are also formed on river bottom lands, where the soil constantly obtains new material from the alluvium, which is very rich in nutritional substances. But in the low parts of the bottom lands these alluvial meadow soils are for the most part too moist and become marshes, although they not infrequently yield large hay harvests.

By the tabulation of the Institute of Soil Management, meadows

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occupy approximately 400,000 square kilometers in the northern zone, and the area of ploughed fields in this zone amounts to the same size. The general area covered by forests on the entire territory of the USSR is accepted to be 9,321,820 square kilometers, (B. I. Seliber, Forest and Lumbering in the USSR, 1930) of which number, 6,179,910 square kilometers is accessible. If we separate from the general forest area forests of the chernozem zone, and also of the Caucasus, the Crimea, and Central Asia (in all, around 510,000 square kilometers), there remains for the northern zone (podsol zone) a forest area of around 8,812,000 square kilometers in all. All these figures are inexact, since only 28 percent of northern forests are inhabited and studied.

Doubtless much land which may still be utilized in agriculture may be found in areas now given over to forests, marshy expanses, and fields yielding fodders as yet unstudied. But how much and to what degree it is accessible may be determined only by a detailed consideration of soils and lands, taking them in small units. One ought not exaggerate their possibilities. The colonization of Siberia under Czarism was going along at a rather rapid tempo when it met great difficulties in planning lots for immigrant settlement among the forest expanses. It was found that suitable lands were already exhausted there -- though, it is true, without reclamation measures having been taken. Doubtless the most practicable and rational thing to do in this case will be to utilize the northern expanses in an economy of combined livestock raising and lumbering.

3. Chernozem Zone

The chernozem zone is largely separated from the podsol zone by a forest-and-steppe belt, the soils of which represent either a

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special kind of northern chernozem or a more or less degraded (i.e., more podsollic, due to the influence of the forest) chernozem. These soils represent in their properties a transition to the chernozem and everywhere in our central belt, for example in the former Ryazan-skaya and Nizhegorodskaya guberniyas, ploughed fields on the grey forest argillaceous soils are considered to be better than the northern podsollic soils. Therefore, we add this transitional belt to the chernozem zone in our general estimate. Grey forest lands of the forest-and-steppe area (on the map legend called very degraded chernozem lands -- III⁽⁵⁾ and III⁽⁶⁾ on the European map, and 13 on the Asiatic map) occupy an area of 474,000 square kilometers, of which a considerable part (around 60 percent) is under deciduous forests. (We do not include here the also very degraded or secondarily-podsolic soils which have the appearance of podsol and preserve in their properties no essential chernozem features.)

Let us mention briefly the basic characteristics of the chernozem. They may be reduced to these:

- (1) The chernozem is notable for a comparatively high quantity of humus (from 4 to 18 percent), uniformly impregnating the mineral mass of the upper layer; (2) the chernozem humus is primarily dark organic matter indissoluble in water; (3) the chernozem soil solution has for the most part a neutral or weakly acid reaction; (4) the absorbant power of the chernozem is high, and it is saturated at the base (which is primarily of calcium) -- so lime is not needed; (5) the upper humus layer of the chernozem has a granular or small-lumpy texture favorable for cultivation and the interpenetration of water and air; (6) the humus layer is continually passing to a lower level and meeting there accumulations of carbonate of lime

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("beloglazka" [little white eye] and other forms), and still deeper gypsum (sulfate of lime); (7) the silicate part of the soil changes very little at a different depth and usually contains an important amount of argillaceous particles; (8) the potency of the humus soil and the depth of the lime accumulation varies within 1 or 2 meters, and stays constant over large areas, characterizing the chernozem "sub-zone"; (9) the chernozem may lie on various rocks: granites, disbases, shales, sandstones, limestones, clays, argillaceous soils, and sands. Their most frequent base however, is yellow-brown carbonaceous (i.e., containing an admixture of carbonate of lime) argillaceous soil, formed from alluvia in the post ice-age period.

These basic features are seen over the entire vast chernozem zone, but quantitatively they differ. In the south as the climate becomes more arid the humus content and the potency of the chernozem fall, while salt accumulations are near to the surface. The rich and potent chernozems of the central zone becomes first ordinary chernozem and then southern chernozem. Towards the north potency and humus content also decrease, while leaching increases. Here the typical chernozems becomes leached and degraded, and still further north they become very much degraded (grey forest soils).

Such a gradation of soils is especially evident in the Central Chernozem Oblast in a northwest to southeast direction. With this, the physical properties of the soil change, as do its structure and also all the other properties important for agriculture.

The diagram appended below indicates how the amount of humus in the chernozems changes according to type and depth. From top to bottom is given the depth of the soil in centimeters. The cross-hatched bars denote humus content in percentages, under these subtypes,

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from left to right: (1) grey forest soil; (2) northern chernozem; (3) leached-out podsol; (4) rich chernozem from the uncultivated steppe; (5) rich chernozem from ploughed land; (6) ordinary chernozem.

We see this gradation in the former Tambovskaya guberniya.

[Diagram]

Towards the west, in the Ukraine, relatively more potent chernozems prevail. They have less humus, while in the east, beyond the Volga the opposite is true: the chernozems are less potent but with more humus, although the latitudinal subzones indicated above may be noted there.

The Cis-Caucasian and Crimean steppes form another special soil zone, which is distinguished for its relatively potent chernozems, in steppe areas slightly leached, with a certain content of carbonate of lime in the top layer and an unusual small-lumpy structure (chernozems of the Sea of Azov region), whereas nearer to the mountains (at Krasnodar, for example) leaching increases but strong potency is preserved.

Siberian chernozems are another special zone. They are for the most part not very potent, or their humus layer descends in

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narrow vertical strata so its thickness is quite variable. In addition, throughout the chernozem zone there are very many solontsy [dark-colored soils with hard prismatic subsoils, usually strongly alkaline] saliferous meadow lands, and the so-called "solods" [soil containing organic salts dissolved from the humus layer]. (This refers only to the chernozems of the western Siberian lowlands, while the Kuznets Basin chernozems are closer to the type of the northern part of the Central Chernozem Zone).

To evaluate all these features from the point of view of agronomy and to express their quantitative importance is very difficult. Leaching and the degradation of the chernozem doubtless leads to a decrease in its richness and a deterioration in its physical properties; which causes a definite demand for fertilizer, with the soil responding even to damp phosphorite. But the less arid climate of the forest-and-steppe sub-zones, on the other hand, favors more stable harvests. Strong, rich chernozems are the most highly endowed of soils, and have in their natural condition the best physical characteristics. The chernozems of the Sea of Azov region evidently approximate these.

Ordinary and southern chernozems characterize a more arid zone. Here the grainy texture becomes coarser, more lumpy, the density of the soils increases, and indications of salinity appear, yet these soils are no less richly endowed than any of the other sub-types. Therefore, in these sub-zones there are principally grain crops.

It is necessary to add that along the river valleys argillaceous chernozems become arenaceous-loamy and arenaceous soils. Yet on high lands of the Donets ridge, the Crimean mountains, the Volga region, and the Cis-Ural belt, and also in Kazak^hstan, there are many

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chernozems abounding in crushed stone.

Finally, the "mountain chernozems" are especially noteworthy. These cover several inter-mountain valleys of Dagestan and the Trans-Caucasus, the Armenian volcanic plateau, the foothills of the Central Asian mountains and a part of the Altay Mountains. These mountain chernozems are a reserve still comparatively little utilized, the total area of which is not less than 100,000 square kilometers, but probably with a considerable number of stony places difficult of access. In the foothills of Tyan'-Shan', the mountain chernozems are very valuable "bogara" (not irrigated) plowlands.

In addition to the strictly chernozem soils in this zone there are also patches and deposits of soils of other types, such as: solontsy, meadow soils, and alluvial soils. These last in certain sections represent a valuable meadow reserve. In western Siberia there are around 390,000 square kilometers of saliferous chernozem steppes and saliferous meadows (zaymishcha), which may also provide a good fodder reserve.

The subtypes indicated above are present in all zones in approximately equal proportions. In the Asiatic part of the USSR the total area of the chernozem zone is considerably smaller than in the European part.

We may draw up the following totals, by subzones:

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<u>Chernozems</u>	<u>European Part</u>	<u>Asiatic Part</u>	<u>Total, in square kilometers</u>
Greatly degraded argillaceous and arenaceous loamy	225,000	171,600	396,600
Degraded and leached argillaceous and arenaceous loamy	258,250	60,900	319,150
Rich and potent argillaceous	251,200	41,200	292,400
Usual argillaceous	230,200	145,000	275,200
Southern argillaceous	176,500	59,800	236,300
Various types of arenaceous loamy and arenaceous	101,300	49,300	150,600
Sea of Azov argillaceous and carbonaceous	104,850	--	104,850
Chernozems in a complex formations with solonetz and "solod"	103,100 ¹	216,100	319,200
Mountain chernozems	<u>16,900</u>	<u>118,100</u>	<u>135,000</u>
Totals	1,467,300	862,000 ²	2,329,300

¹ Principally in the Trans-Ural region.

² In addition, 74,00 square kilometers of zaymischa located in western Siberia.

It is evident from this table that the most typical chernozems (the 2nd, 3rd, 4th, and 7th on the table) occupy on the whole around 1,000,000 square kilometers, almost all ploughed; while in other parts of the zone around 50 percent of the total area is ploughed. On the whole, the area of ploughed land in the chernozem zone reaches, in round figures, 1,500,000 square kilometers.

We should not say that the process of land utilization is completed even in the chernozem zone, although no "free" land remains

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here except for areas of deciduous forests, saliferous chernozems, and the so-called seropesky ⁱ [gray sands], and also zaymishcha and alluvial meadows. But it is obvious that the specialization of zones and the intensification of agriculture may still increase the productivity of the chernozem zone. With regional specialization (in particular crops and in combined types of farming), crops are located, firstly, according to latitudinal subzones, secondly, according to basic types of chernozem (solonetz, arenaceous-loamy, mountain), and, thirdly, according to a combination of climate and soils (the Ukraine, the Central Chernozem Zone, the Trans-Volga region, the North Caucasus, Siberia). The fact is that the latitudinal chernozem subzones do not indicate all the interrelations of climate, soil, and vegetation -- in addition we must make district and county subdivisions. For example, on the southern chernozem of different districts the combination of crops may be different, and winter wheat of the western districts becomes in the east exclusively spring wheat, etc. Consequently, our totals on the preceding table will be broken down still further into administrative districts on our basic tables.

Not long ago, Professor Marbut, an American soil scientist, visiting our country at the time of the Second International Congress of Soil Scientists, compared the area of our chernozem to the American chernozem from the standpoint of wheat production on the world market, and arrived at the conclusion that the USSR has here an advantage over the United States. (C. S. Marbut. "Russia and the United States in the World's Wheat Market." Geographical Review, 1931, I. In the October issue of the same magazine, the second article of Professor Marbut was published, "Agriculture in the United

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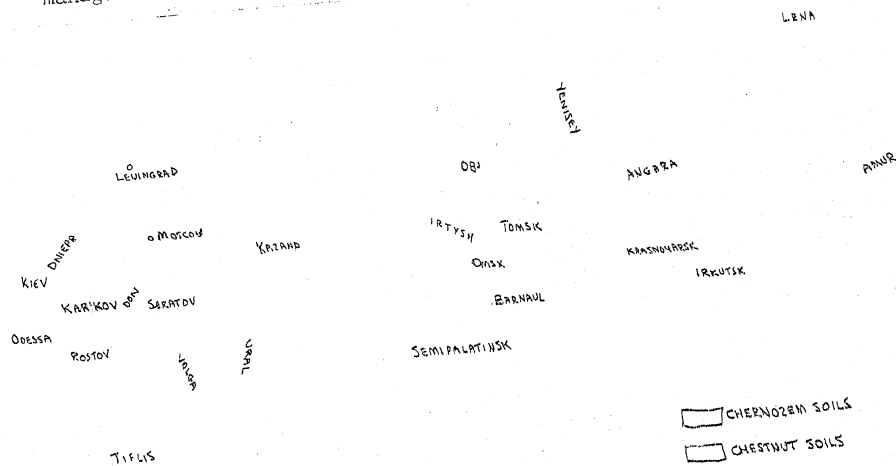
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States and Russia," where he points out that the US has on the other hand more varied conditions, favoring, among other things, the cultivation of technical crops, especially cotton.) According to his estimate:

the area of the chernozem in the USSR is . . . 195,291,930 hectares
 the area of the chernozem in the US is . . . 40,088,740 hectares
 the area of chestnut soils and poorer
 chernozems in the USSR is 150,525,350 hectares
 the area of the same, in the US is 54,831,995 hectares

This relationship was indicated on two small maps, copies of which are reproduced here. (Professor Marbut evidently used an old soil map of the Soviet Union, one appended to a textbook on soil management by K. D. Glinka.)



In his estimates, Marbut does not add to the area producing wheat the central states of the US, for example Iowa, Illinois, Ohio, and others, since wheat cultivation there is comparatively small. He

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marks in crosshatches on his map only the arid steppe zone corresponding to our southern chernozem subzone, although in the central states named, as is well-known, chernozems are also widespread which correspond to our leached and degraded chernozems (prairie soils). Meanwhile in Eurasia Marbut shows all the chernozem zone, in his arrangement only leaving out a part of the forest-and-steppe central chernozem belt and the Central Volga region. In addition, the eastern Siberian chernozem is mistakenly shown as chestnut soil, whereas here more frequently forest-and-steppe soils are predominant. (This mistake is again made on Marbut's map and in his second article. On the maps of Professor Marbut the darker crosshatching signifies chernozems, and the lighter signifies chestnut soils together with the poorer chernozems.) On the other hand, Marbut entirely omits chernozems of the eastern Transbaykal region (Nerchinsk steppe, etc.) The tongue of chestnut soil placed south from Semipalatinsk through Lake Balkhash is probably a mistake.

Therefore Marbut's estimate needs revisions, especially if one considers the specialization of agricultural districts we have proposed, with wheat crops predominating in the southern part of the chernozem zone.

It is evident from our table that the area of the chernozem zone is on the whole larger than Marbut has indicated. And the zone of chestnut soils is also larger. In all, the area of ploughed lands in both zones is now around 1,600,000 square kilometers. A 30 percent increase in this area is possible, and also a large expansion of the use of agricultural engineering measures.

But all these corrections do not change the general conclusion of Professor Marbut, which is essentially true.

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4. Zone of Arid Steppes and Chestnut Soils

This zone forms the extreme southeast of the western European plain. Broken by the semi-circle of lands in the depression around the Caspian Sea, it continues towards the east as a wide belt, occupying a large part of Kazakstan and entering the borderland low parts of Eastern Siberia -- the Minusinskiy, Selenginskiy, and Argunskiy districts. To the west of the Caspian Sea, it is intersected by the Manych and Don approximately opposite the Donets River depression. Only in the lowest part of the Tavricheskiy peninsula and in a narrow belt on the lower northern and western banks of the Black Sea may dry mugwort steppes be seen, with soils of chestnut shades and saliferous, but of a somewhat other type than in the southeast. Also, in the southern mountain districts of Transcaucasia and Central Asia, going from the arid steppes of the plains to the low foothills, comparable chestnut soils are found.

Soils of these steppes differ, in having a small humus content (2 to 4 percent) and a humus layer of little depth. The arid climate with a hot summer and cold winter permits only temporary surface soil moistening, so that near the surface salt accumulations are retained, not only calcium salts which do not dissolve easily, but also easily dissolved chlorine and sulfuric acid salts of alkalis. The entire design of the soil seems constricted in comparison with the chernozem. Grainy and small-lumpy texture disappears completely, and the soil is either powdery or forms coarse heavy lumps. In addition, owing to the dryness of the air and strong evaporation, salts here, with the ground level of the water near, are everywhere on the surface of the land. These have their origin in saliferous clays deposited by the ancient basin of the Aralo-Caspian, and also in other sea deposits which outcrop in many places in this zone.

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According to the theory of K. K. Gedroyts, with the lowering of the level of subsurface water the original solonchaky or saliferous clays begin to be slowly leached out and to lose their salts, but in the form of humus and clay particles the soils are absorbed into their base of alkaline salts (chiefly sodium). With moistening, these particles may wash down to some depth in a particular diluted condition. Then, the upper layer of the soil loses its clay particles and becomes sandy and dusty, while the lower layer thickens and acquires a characteristic acicular texture. Thus, solonchaky become solontsy and soils in various degrees saliferous, forming a complicated diverse complex characteristic of the arid steppes of Kazak^hstan and the Lower Volga region. (In Siberia and in the black earth zone there are very many of them.) Solonetz soils may be frequently ploughed, and in moist weather give good harvests, but in time of drought, crops are first to die off on these soils. Solonetz soils must be irrigated with great care, since their physical properties are unfavorable to irrigation. The problem here of securing of sources of fresh water for drinking and for machines is very important and even acute. Irrigation is essential, and we must use all possible means to have it.

The transition from the chernozem towards the south and southeast is very gradual. At first, there is a wide belt of dark-chestnut soils, close in quality to the southern chernozems and still largely ploughed. Further to the south there are light-chestnut soils, for the most part combined with saliferous soils and therefore in this area the ploughed fields always have lumpy soil, and irrigation is little utilized because of the lack of water and the danger of salting the soil.

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We ought to note that in Kazakhstan chestnut soils frequently alternate with rocky steppe land in districts of the so-called melkosopchnik, which consists of remnants of the erosion of ancient mountains, where there are outcroppings of various dense rocks -- granites, quartzites, slates, etc. -- as a consequence of which the soils are not suitable for agriculture.

Ploughed fields comprise less than 10 percent of this zone. A large part of the expanse is occupied by saliferous and stony steppe pasture land (up to 60 percent). But if we add up areas, for example the chestnut soil areas, which are set aside as having soils of saliferous composition and very rocky places, and therefore conditionally suitable for agriculture, then we have, together with a part of the foothill non-irrigated steppes, around 600,000 square kilometers. So "dry farming" still has adequate unused land resources here. The voluminous material from investigations in recent years in Kazakhstan can indicate in exactly which districts these lands are located. Unfortunately, this material is still for the most part uncorrelated and could not be used in our computations.

The Kazakhstan and Lower Volga region also have in their river bottom lands considerable meadow expanses, as steppe "estuaries" and as the so-called "overflows" [razlivy] (on the lower Ural River). With the resolution here of irrigation problems, the present relationships among farm lands evidently will be changed. The largest area, though, will be given over to grain crops and livestock raising.

5. Zone of Barren Steppes and Gray Earth

Soils of the barren steppes are called serozemy [gray-earth soils], since an insignificant amount of organic matter (humus), usually less than 2 percent, together with a certain amount of

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carbonate of calcium, very often imparts to the surface itself, especially on watered fields, a grayish or more properly yellowish-gray shade. The maximum aridity and hotness of this zone's climate, where the yearly total precipitation in places does not reach even 100 millimeters, conditions the small quantity of humus with, concurrently, very weak leaching of salts. So there are very few solonchaky here. Soils of lowlands are all more or less salted, and the converse losing of salts with the formation of solontsy (as with chestnut soils and chernozems) is seen relatively seldom. More often, salted irrigated fields or flat lowlands where rain waters accumulate become unique ^{compact} soils known as makry. In many cases in the serozem zone an accumulation of sulfuric acid salts is seen close to the surface, primarily of gypsum (CaSO_4), often in the form of an unbroken layer of crystals. These accumulations are especially noticeable in pebbly-gravelly barren soils, and lie so near the surface that they can be seen in ruts on a road. They are also sometimes observed in sandy soils, where they make large evenly formed crystals, half consisting of sand (for example, at the Repetek station). Frequently sulfate and other salts bleach out onto the surface as a crust, in connection with which their crystallization induces swelling and loosening of the soil, and the so-called "swollen solonchaky" are obtained (locally known as kebiry). Also very characteristic is the formation of saltpeter in certain places where organic waste materials have accumulated.

Yet one cannot say that the salt solution in all soils of this zone is on the whole harmful to plants. Where depositions have not again formed and where the level of subsurface water is low, soils have, however, leached out gradually over the centuries

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and even a part of the relatively immovable carbonate of calcium washes down to some depth. All probabilities are that not all depositions on which serozem soils have formed were originally salted -- for example, loess of the high flatlands and the foothills were probably deposited by the muddy waters of streams issuing from under ancient glaciers. With the subsequent lowering of the places where these currents flowed and the shaping of the modern river valleys, these loess alluvia were eroded, forming hills and benches on the foothills or plains, level though above the river beds. Upon these were formed the typical loess soils of the barren-steppe zone -- serozemy which are the chief resources of cultivated lands of Central Asia, its chief wealth, long artificially irrigated by canals, nourished by the waters of the Syr-Dar'ya, the Amu-Dar'ya and other rivers. Loess, a finely porous rock with small granular texture, water-permeable, is favorable to irrigation. There is good natural drainage because of the hilly terrain of the foothill plains. This makes it possible to water the crops here without making the soil salty, in spite of the fact that many centuries have passed since the old oases of Tashkent, Samarkand, and other similar places first used irrigation.

Such typical serozemy on loess (25 on the Asiatic map) encircle in a narrow winding belt the foothills of mountains of Central Asia, occupying in general an area of around 85,600 square kilometers. We must realize, though, that on the general map all details of this belt could not be separated, and therefore, there also appear on it sections which are not loess and are unsuitable for agriculture -- for example, ledges of the old conglomerates, different dense rocks, etc. In addition, in the loess belt itself there are many places too much broken up with hills for irrigation.

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On the low plains under the mountains, where the climate is much dryer and hotter than in the foothills, and where processes of salting and erosion (i. e., washing out, weathering, and other phenomena of the destruction of the soil surface) are effective, serozemy of a lighter shade are seen, with an insignificant humus content. These alternate here with solonchaky, takyry, stony waste lands, new unstable affluvia, and, finally, with sandy waste lands. These lands no less than the barren serozemy (often of various bright colors) would be a valuable land reserve with irrigation, and some of them also have long since been transformed into oases (for example, the oases of Khorezm).

Professor Albrecht Penck, the well-known German geographer, who is much occupied with questions of the future (as he incorrectly believes it) resettlement of land, in his recent report to the London Geographical Society concerning the potential capacity of Central Asia for resettlement, called attention to the fact that the Amu-Dar'ya and Cyr-Dar'ya Rivers carry into the Aral Sea and Lake Balkhash so much water that in the course of a year a one-meter layer is added to their surface of approximately 83,300 square kilometers -- so approximately a third of this land might be irrigated and transformed into oases. (Zentral Asien. Zeitschrift der Gesellschaft für Erdkunde zu Berlin. 1931, number 1-2).

Measuring on a map the whole expanse of serozems except for areas of continuous sand, solonchaky, and stony waste lands, we obtain an area of around 120,000 square kilometers (not counting tugay lands), of which not more than 1/3 is at present oasis land. Thus, there is still a rather large reserve of lands for irrigation, which are now marked out for use in Tadzhikistan and other districts. The

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area of stony and sandy wastelands is, nonetheless, huge, and predominates in size in our Central Asia republics, where it numbers:

serozemy with solonchaky and stony,
 takyry, sandy serozemy, etc. 860,800 square kilometers
 sandy wastelands 742,600 square kilometers

All this land is utilized for winter or fall pasture. Among the sandy wastelands there are also haloxene forests valuable for fuel, with a total area of 120,000 square kilometers. As places for raising caracul lambs, certain sands are rated by specialists as no less profitable than the chernozemy. One must add to this the possibility of using certain sands for rubber bearing plants which are gathered wild or cultivated.

To the serozem zone also belong certain parts of Azerbaidzhan, Dagestan, the North-Caucasus region, and the Kalmyk region, in the foothills of the Caucasus along the Caspian Sea, and also a small part of Armenia. Here serozems are widespread, mainly on very new alluvia (on loess), but with irrigation, they are partially used for cultivating cotton, etc. In the North Caucasus, in the Kalmyk region and the Trans-Volga (in the former Bukeev Orda) there are also huge sand expanses much of which are drifting sand dunes.

In all there number in the European part of the USSR around 80,000 square kilometers of serozemy and light-brown soils similar to them, of which half are arenaceous-loamy (in the lower Volga). Of light-brown soils, only the soils of the so-called Berovskiy mounds in the Volga delta around Astrakhan are, with irrigation partly utilized for fruit growing.

The zone of barren steppes has great potentialities, owing to the abundance of light and heat, and owing to the fact that there

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still is water in the rivers available for irrigation, the water flowing from the mountains onto these desert plains.

6. Subtropic Zone

In the Transcaucasus at Lenkoran', and on the Black Sea littoral from Sochi to Batum, the soils are unlike all others in the Soviet Union -- krasnozemy [red-earth soils] and zheltzemy [yellow-earth soils], and brown forest soils in a stage of transition to krasnozemy and zheltzemy. The latter, however, extend much further onto the slopes of the Caucasus, under deciduous forests. Krasnozemy and zheltzemy are notable for the fact that they are greatly leached (contain no lime) yet not transformed into podsol -- on the contrary, they contain comparatively little silica, but are rich in clay (or in part with hydrates of iron and aluminum). They are essentially different from podsoles, in which silica is accumulated and clay particles are washed beneath. But krasnozemy also have an acid reaction, and their absorption ability remains, as their base is not saturated. The brown forest soils of the southern deciduous forests occupy an intermediate place between them.

It is conjectured that krasnozemy of the Batum area (such as red laterite tropical soils) originate not so much in modern as in ancient processes of the weathering of chiefly volcanic rocks. In natural state under forest trees, humus accumulates on the surface of the soil and bleaches out, as do the forest podsollic soils of the northern forests. Brought under cultivation, this upper layer is easily washed off, and the lower layer of ancient red clay comes to the surface. It is also known that on the low littoral terraces from Sochi to Batum there are unique soils similar to the northern podsoles, though not exactly like them, and in the

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lower reaches of the Rion River there are also large peat bogs. However, a full analogy to northern conditions cannot be found here, because of the influence of the warm moist subtropic climate of the Black Sea littoral, with precipitation 1,500 to 2,000 and more millimeters yearly. And whatever is the origin of the krasnozemy, they represent, apparently, especially favorable soil for certain crops, for example, tea.

Brown forest soils, being leached and having no salts, but comparatively clayey and not lacking nutritive elements, may also be preferred for certain crops, such as fruit trees, certain varieties of tobacco, etc.

The area of the krasnozemy of Batum and Lenkoran' is established (very approximately) as 5,800 square kilometers. The area of the brown forest soils in the Caucasus and in the Crimea is as much as 62,000 square kilometers, and almost all of it is found in forests, some of which are very valuable timber, and some of which are deteriorated, sparse and scrubby woods.

7. Soils of High-Mountain Regions

Especially distinctive are high mountain regions of the Caucasus, Tyan'-Shan', the Altay Mountains, ^{Sayan Mountains} ~~Mount Sayanok~~, the Cherskiy ridge, and others, above the forest zone, with perpetual snow and glaciers on the heights. Also, in the Caucasus, Tyan'-Shan', and in the Altay Mountains, above the forest zone is a still wider zone of subalpine and alpine mountain forests, representing excellent summer pasture land, and in some places (in the subalpine zone) are utilized on a small scale for barley cultivation. Mountain-meadow soils are a special type -- leached, more or less rich in humus, but not swampy, bearing especially abundant flora. Soils of the

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subalpine meadows are more like the chernozem soils. But, since usually mountain meadows, especially those of the high alpine zone, alternate with rocky slopes and heights, of course we cannot consider the available area in the mountain meadow zone to be more than half of the total area. This is particularly true because many mountain meadows are damaged by excessive pasturing and are eroded by mountain streams. Here soil preservation should be practiced. On the high tablelands of Tyan'-Shan' (the so-called syrty), for example in the Altay valley, in the Archa valley and Lake Chatyrkul', instead of mountain meadows there are unique high-mountain steppes. These occur on the high tablelands of the western Altays (in Oyratiya). They have unique mountain-steppe soils somewhat reminiscent of the chestnut soils of arid steppes. These soils are all good pasture lands.

On the most western branches of the Tyan'-Shan' system in Kirgiziya, Uzbekistan, and Tadzhikistan, the zone of mountain meadows is very little developed. Here the arid mountain steppes -- partly, even, saliferous -- rise to great heights (43 on the Asiatic map), while on the Pamir Mountains at heights of around 4,000 meters above sea level real wastelands are seen, with soil reminiscent of the serozemy of the low flat lands of Central Asia. The mountains of Siberia (beginning with the Altays) and the Far East (and even the northern Urals) have no mountain-meadow zone. They are covered to their tops with forests, and only the very highest places represent "gol'tsy" [barren mountain summits], where vegetation and soils are somewhat reminiscent of the tundra of the Far North. The upper boundary of the forest on the southern frontier of Siberia lies at a great height (1500 to 2000 meters), while in the north it gradually

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becomes lower, so that on the ridges of Yakutia and in the Far East (in its northern half), gol'tsy occupy a very large expanse. In Siberia, gol'tsy occupy in all 286,000 square kilometers. A very large expanse is occupied also by the "podgol'tsevaya below the barren summit zone" of mountains, covered by stunted forests, stony areas, and more or less marshy soils, in all around 843,000 square kilometers. All this is comparatively inaccessible, good only for hunting and trapping (and in some places, for gathering cedar nuts). (The Altay mountain forests, the so-called "chern" "darkness", occupying around 144,000 square kilometers, are considered separately.)

Finally, an entirely separate type is the volcanic mountains of Kamchatka, covered on their heights by perpetual snow, with stony places and lava beds below.

III. GENERAL CONCLUSIONS CONCERNING THE DISTRIBUTION AND UTILIZATION OF SOILS BY ZONES AND REGIONS

In order to represent the relation between soils and the field under cultivation, let us compare the distribution of soils in individual administrative oblasts on our tables with the statistics available on what types of fields predominate in these oblasts.

In this we use computations in part made by workers of the Institute of Soil Management, in part derived from reference books and resumes on the subject. Here there is no possibility of introducing detailed land statistics and proving them, since our computations, while necessary, are important only as general indications (indexes) of the comparative uses of soils. The problem of achieving an exact calculation and mapping of fields may be resolved in the very near future with the utilization of local

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materials and with the cooperation of agricultural statisticians. This objective cannot be avoided, for it is needed as a basis for planning land improvements in our whole country, from the tundra to the hot barren lands and the mountain heights.

On first looking at the basic tables, it is already evident that almost all our administrative subdivisions (oblasts, krays, autonomous oblasts, federated republics), notwithstanding the huge expanse of some of them, in part coincide with the division into natural zones, which is:

1. In the zone of podsol and tundra are: the Northern Kray, the Murmansk Okrug of the Leningrad Oblast, Yakutia, the Far East, the Ural Oblast, and the Siberian Kray (10 percent of the last two is in the chernozem zone).

2. In the zone of podsol without tundra: Karelia, the Leningrad Oblast, the Western Oblast, Belorussia, the Moscow and Ivanov Oblasts, the Nizhegorod Kray (15 percent of it in the chernozem zone), and Buryato-Mongolia (10 percent in the chernozem zone).

3. In the chernozem (and forest-and-steppe) zone:

The Ukraine	(20 percent in the podsol zone)
Central Chernozem Region.	(15 percent " " " ")
Middle-Volga Territory.	(10 percent " " " ")

Tatar ASSR

The Crimea (40 percent in the chestnut-soil zone and 20 percent mountain-forest)

The North Caucasus (20 percent in chestnut-soil and 15 percent in the mountain zone)

Bashkiria (25 percent in the podsol zone)

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The Lower-Volga territory (30 percent in the chernozem zone)

Kazakstan (10 percent in the chernozem zone)

5. In the serozem /gray-earth/ zone -- Turkmenia and Karakalpakiya6. In the serozem zone, high-mountain districts:

Dagestan (around 25 percent mountains)

Transcaucasia. (around 60 percent mountains)

Tadzhikistan and Uzbekistan. (around 50 percent mountains)

Kirgizia (around 85 percent mountains)

The least homogenous of these are the Siberian territory, the North Caucasus, Dagestan, Transcaucasia. But the western part of the Siberian territory is more homogenous. The vast extent of the tundra, swamp, arid and stony steppe lands, sand areas, solonchaki, solontsy, and high-mountain areas gives one a conception of the relatively low capacity of the land.

The largest expanse of these "unsuitable" places is found in:

Murmansk territory	) much tundra and marshland
Northern territory	
Siberian territory	
Ural region	
Yakutia	) tundra and mountains (gol'tsy)
The Far East	

Buryato-Mongolia -- mountainous districts

Lower Volga territory -- deserts and solontsy

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Kazak^hstan stony steppes, solontsy, and
 "malovod^yie" [semi-arid land]
 Turkmenia deserts, stony wastelands,
 solonchaki, and "malovod^yie"
 Tadzhikistan)
 Kirg^hizia) mountainous districts
 Dagestan deserts, solonchaki, mountains

But in all these districts the lack of suitable lands is compensated for by mineral wealth, or by various means of exploiting the land or by the possibility of expanding industrial crops. Agricultural specialization, is called for by all conditions of industrialization of the USSR.

In the table below appended, a calculation is made of the areas of soil zones on the whole (guided only by a soil map), and we try to estimate which types of fields each zone contains. In this, certain numbers are deliberately rounded off in hundreds of thousands of square kilometers. We see that the distribution of fields is subject to natural climatic and soil zonality. The northern zone is almost 95 percent occupied by forests, marshes, and tundra. Three quarters of all the plowed land of the Soviet Union is at present in the chernozem zone. Of all the southern zone, not more than 5 percent is under cultivation; the rest is primitive pasture land, barren steppes, or mountains. From this one may see how greatly agriculture still depends on natural conditions, particularly on soils, and how important it is for plant cultivation and livestock raising to know how to rationally utilize these, and to remake them.

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The problems which arise in this matter are more or less well known, but they will become still clearer if we estimate, now, utilizing the following table, the total number of fields in all the Soviet Union, dividing them into 3 categories.

GENERAL ESTIMATE OF AGRICULTURAL LAND IN THE USSR

	<u>Area, in square kilometers</u>
 1. UNSUITABLE LANDS OUTSIDE OF THE ZONE OF AGRICULTURE:	
Tundra and forest-and-tundra (total)	3,200,000
Mountain tundra (gol'tsy)	290,000
High-mountain barren lands of the Pamirs	34,000
Deteriorated or inaccessible mountain meadows.	95,000
Land under snow, glaciers, water, and various unstudied and unused expanses	588,000
Desert lands of barren districts (total)	775,000
Stony barren lands and solonchaki.	700,000
Total, Group I	5,682,800
 II. UNSUITABLE LANDS WITHIN THE ZONE OF AGRICULTURE:	
Unsuitable forest areas (except for haloxyla).	3,200,000
Marshes of various kinds	1,500,000
Chernozem solonetz steppes	320,000
Zaymishcha in Western Siberia.	75,000
Mountain steppes	250,000

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kilometersII. UNSUITABLE LANDS WITHIN THE ZONE OF
AGRICULTURE (Continued):

Solonet z steppes of the chestnut-soil zone	460,000
Stony steppes of the chestnut-soil zone.	370,000
Takyry in Central Asia	110,000
Plavni <u>shore-land</u> and small islands, stony, with bush vegetation and and tugai	65,000
Total, Group II.	6,170,000

III. SUITABLE LANDS

Plowed lands	2,050,000
Meadows (irrigated, dry-valley, ^{liman} marsh , etc.	450,000
Forest suitable areas.	6,180,000
Pastures on suitable lands in the chestnut-soil zone.	500,000
Pastures on suitable lands in the serozem zone	140,000
Mountain steppes ($\frac{1}{3}$ of the entire area	120,000
Mountain meadows ($\frac{1}{2}$ of the entire area	90,000
Total, Group III	9,530,000

From this estimate it is evident that the area of possible reclamation is large, even if one rejects entirely the lands of Group I, The 2nd, 3rd, 4th, 6th, 8th, and 9th categories in Group IV belong entirely to the reserve for future reclamation, and in

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any case can give excellent fodder fields or their production can be considerably raised above what it was under primitive farming methods. Figures for the last group indicate that for the expansion of the present sowing area there is a considerable reserve.

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In attempting to carefully divide this into basic areas we receive the following totals:

Reserve for the expansion of the sowing area	In square kilometers
1 From forests (5 percent of the suitable area)	300,000
2 From marshes (10 percent)	150,000
3 Mountain chernozem steppe (30 percent). . . .	40,000
4 Saliniferous chernozem steppe (10 percent). .	30,000
5 From deciduous forests of the chernozem zone (10 percent)	30,000
6 Steppes with chestnut soils (30 percent of the suitable area)	200,000
7 Steppes with serozemy (30 percent of the suitable area)	40,000
8 Takyry of Central Asia (20 percent)	22,000
9 Plavni (30 percent)	5,000
Total	817,000

In this way, with most careful computation of areas and soils, which in fact, already are being turned to agriculture at the present time, our ploughed land can be increased approximately 40 percent over the areas and soils now under cultivation.

This increase may be achieved in all zones, although not equally. First in order, obviously, is the utilization of chestnut soils in "dry farming" under grain crops (for the most part in Kazakhstan).

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As has been already said, here the chief obstacles to the utilization of lands are arid climate, salinity of soils, and lack of water. Therefore, the profitableness of utilizing the arid steppes for land cultivation might be disputed in favor of an economy of livestock-raising alone.

The next largest reserve is in the northern districts, for the utilization of which radical improvements are demanded, partially already begun and carried out. There is a certain reserve in the chernozem zone, and then in the serozem zone, and also in our subtropics. The latter are not isolated on our composite tables because due to their small general areas their occurrence must be exactly calculated, and this calculation has still not been made. But here we are not concerned with the huge areas which are needed for wheat or fodder cultivation. An expansion of the area of individual crops in the south cannot influence the general disposition of the sowing area, and therefore the exclusion of individual southern crops in favor of fodder crops and crops for local subsistence is always possible.

Obviously it is very important to consider land utilization with crop specialization, and with the value of the utilization, considering also here the possible construction of industrial centers. Favorable and unfavorable soil and geographic properties, while they have no absolute importance, nonetheless very substantially influence the profitableness and relative utility of one or another method of land utilization, and hence influence the desirability of corresponding agricultural methods. The objective of this study will be reached if, even in a first approximation it clarifies these problems raised.

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LARGE PROJECTS AND RECLAMATION
PROBLEMS IN THE USSR, IN CONNECTION WITH THE
TASKS OF HORTICULTURE

A. N. Kostikov

I

Socialist reconstruction of the USSR agriculture, which opened great possibilities for the development of all its branches, brings up daily greater requirements for new lands suitable for establishing large Soviet or collective farms, for the development of the various crops necessary for our national economy. And during the coming years these requirements will be increasing.

Under such circumstances it is quite natural that in a number of areas and concerning a number of farm crops, we already are faced with the necessity, and in other areas with other crops we shall reach very soon the necessity of conversion to agricultural use, large land areas which need various types of reclamation work to be done before they can be used effectively.

These are either lands which are now not used at all or else are not used adequately (not completely, not intensely enough), the so-called "inconvenient" lands of different kinds.

The total surface of such lands in the USSR is very great, counted by scores of millions of hectares. In most of the areas it is accounted for only approximately, and in many others only partly or even not at all. It stands to reason that, from this enormous land fund the transition to proper agricultural use is and will be taking place first on lands in the districts where the need for the widening of agricultural areas is most actual, and in such land sections which are to a certain degree already known and which will most efficiently

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contribute to the solving of farm problems in each of the sections under consideration.

The purpose of this article is to point out these separate more or less large land bodies on the background of general quantitative data on unutilized inconvenient lands in certain areas of the USSR. As a result of applying expedient reclamation measures, these lands could be turned over to proper agricultural use, and specialized Soviet and collective farms could be created on them. Appropriate land and farm organizations mark most of these land bodies as more or less near future projects for large reclamation development and the information about them is compiled from the data of the ^{"Soyuzvodkhoz"} ~~"Soyuzvodkhoz"~~ (Union of Water Economy), the Melioration Institute's economical sector, the "Giprovd" and other organizations; some projects, with the data furnished by individuals who know some of the sections, is also added to the list. Our reclamation statistics and reclamation cadastre are completely unorganized yet, and therefore all the given data and information are only approximate and in no measure exhaustive. Besides that, the author considers it necessary to stress that he excludes it completely from his purpose to give a comparative evaluation of the mentioned projects among themselves, as well as with possible other projects which (due to lack of data) did not enter the visual field. The reported information is only preliminary orientation data, which can be used as material for the choice of projects and solving concrete problems on extending the area under one or another crop during the second 5-Year Plan as well as the following years.

II

If we turn to the distribution of unutilized, so-called "inconvenient" lands on USSR territory, we shall see that in this distribution a definite zonal regularity can be observed in the sense of the

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amount of these lands as well as their nature or quality.

The distribution of "inconvenient" lands requiring reclamation corresponds with the basic zones of water balance of the areas of which it is composed. There are three of those zones which differ from each other in the rates between the influx and discharge elements of the water balance: in the first zone the influx elements are above the discharge ones, in the second both element groups are more or less balanced and, finally, in the third zone the discharge elements are above the influx elements of the water balance. The relation between the elements and therefore the water balance conditions of a certain territory can be characterized by a certain water balance coefficient representing the ratio $\frac{\mu - P}{E}$, where μ equals one minus the discharge coefficient; P - amount of precipitation on given territory during the period under observation (for example, a year) and E - evaporation of moisture, on the same territory, during the same period of time. Thus, for the first zone the water balance coefficient is steadily above one, this is the zone of excess humidification; for the second zone the water balance coefficient is close to one, deviating from it within a small range, this is the zone of unsteady humidification; and, finally, in the third zone the water balance coefficient is steadily under one, this is the arid zone of insufficient humidification. Each of these zones (which differ in the direction of their water balance), correspond to the quite definite hydrological conditions which result. This determines also the particular direction of soil-building processes, and therefore also the basic (predominant) type of "inconvenient" lands and what kind of reclamation work it needs. The so-called "inconvenient" lands, on the background of these general hydrological conditions and soil-building processes, are only those focal points where these general conditions and processes (due to local causes) are most sharply defined.

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Accordingly, the "inconvenient" lands will be qualitatively and quantitatively expressed stronger, the more unregulated the water balance of the given territory, the farther the average (mode) deviates from unity, and the importance of the coefficient of its water balance. It is thus understandable that the greatest amount of "inconvenient" lands and their most extreme manifestation and therefore the greatest need for reclamation, we find in the first and third zones -- zones of excessive and insufficient humidification.

The first zone -- that of excessive humidification, occupying the northern and northwest area of the USSR -- is the zone of predominating arid and anhydrous territories -- steppes, semi-deserts and deserts, sands, and saline soils.

Between these zones there is the second zone of unsteady humidification. This is a more or less wide belt extending from the east and southeast, to the west and northwest of the USSR. It forms a transition between the first and third zones: the zone of the dying out swamping processes and the appearance in its southern parts of semi-arid territories, ravines and sands.

III

The excessive humidification zone includes the following USSR areas: the Northern region, the Leningrad oblast, the Western oblast, BSSR [Belorussia], the Moscow Oblast, Ivanovo Oblast and Nizhegorodsk Oblast, most of the Ural'sk Oblast, as well as the northern and northeastern parts of Siberia.

As mentioned before, the water balance coefficient in this zone is steadily above "one", fluctuating in different sections from 2.0 to 1.5-1.4. Due to this characteristic of the water balance and to the

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fact that the moisture influx is greater than its consumption, the following hydrological and soil conditions are characteristic for the excessive humidification zone; more or less near-surface occurrence of ground water levels; great density of the hydrographic system; high standing of water levels in the majority of water streams; a comparatively low filter capacity of many of them; and, finally, the presence of enormous swamp areas and swampy lands in different stages of swampiness. In various parts of the zone all these conditions are expressed strongly or weakly depending on "local" factors, but the general degree of their expression diminishes in the northwest to southeast direction, together with the decreasing significance of the water balance coefficient.

From the indicated water balance direction (characteristic for the excessive humidification zone), it is possible to judge the basic type of reclamation needed here. Since we are not able to influence substantially such water balance factors as precipitation and evaporation, efforts of reclamation must be directed to the flow of water. It follows that there must be the needed speeding up of the flow of surface water as well as of ground waters in the lands being improved. Therefore, reclamation in the excessive humidification zone leads first of all to the regulation of the water intake of the swampy rivers and streams, to increasing their water runoff capacity. Without this, all other measures of drainage would have little significance. The second group of measures to be undertaken is to connect the area being drained by a system of main and secondary drainage canals. Finally, on the basis of this general introduction of canals, the water supply of the reclaimed land should be and can be regulated. This is done with the proper drying or drainage, together with whatever else has to be done in terms of the requirements of growing one or another crop on these

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lands. For many meadows and forested areas, the first task will be to take the proper steps in preparing for the particular crops: cutting down hillocks, cutting and notching, etc.

The primary targets for reclamation will be the vast swampy bottom lands and many river valleys of the zone under consideration, in order to utilize them intensely, mainly for meadows and partly for vegetables and other crops. In many cases of bottom land reclamation, it will be quite pertinent to raise the question of regulating not only their water, but their nutrition as well by way of using, besides draining, irrigation with spring freshets rich in silt. The purpose of this is not humidification, but fertilization and compensation for nutritive substances (mainly potassium) which are found in inadequate quantities in swampy soils. Further, of great importance in the zone under consideration, will be the drying and draining of the excessively-humidified mineral soils which are becoming swampy, arable lands as well as in areas converted from forest into lands to be used for flax, dairy-vegetable and in the extreme North (Karelo-Murmansk and Northern ^{Krays} ~~so-~~ ~~gions~~) also for Soviet and collective grain farms. As to the forests, a considerable part of them is swampy (mainly water dividing moss swamps). The question of forest draining is raised with the purpose of creating normal conditions to extend plantings. Of no less essential importance, however, is the question of converting surplus forest areas to agricultural use. This applies to forest areas with 25-30 per cent above the normal amount of timber. In the zone under consideration, this constitutes a total area on the order of 44 million hectares (Northern ^{Kray} ~~region~~ - 28 million hectares; Leningrad Oblast - 2.0 million hectares; Western Oblast - 2.0 million hectares; Central Oblast - 2.0 million hectares; and Ural Oblast - 10 million hectares). The agricultural use of these areas will require, besides uprooting and ploughing, also drainage work in part of these areas.

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The swamp area in the entire excessively humid zone, not counting Siberia, constitutes about 56 million hectares (on the average 20 per cent of the total area); of these, about 38 million hectares are in the extreme north and the tundra; besides them, the area comprises about 18 million hectares, of which about 8-9 million hectares are moss and forest marshes and the remaining area consists of transitory, depression and bottom land swamps. Excess humidity and mineral soils becoming swampy are not accounted for, and are not included in the above figures. According to very tentative information, the excessively humid lands occupy about 3.0 million hectares of the existing arable land. Thus, the total area of agricultural importance (meadows, forest, gardens) which needs to be drained, amounts to 13-14 million hectares of the zone under consideration, not counting the draining of parts of areas cleared of forests, and the reclamation of forests and swamps in Siberia.

The largest reclamation projects envisaged at present (river regulation, partly due to slides and drying up) on the entire enormous, above mentioned swampy area, are given in the proper table. In the above mentioned index are included only the projects which are more or less outlined according to the present time data of the land organizations. They are included in the present five-year plan, and in part relate to the following period. Not included are many projects which will become apparent during the following years in connection with the development of industry and transportation, etc. Many draining projects are in the north, in connection with the planned Kama-Pechora waterway, and others. As to the excessively humid zone within the borders of Siberia, it still is outside the agricultural belt and the amount of swamps here is completely disregarded. Siberia's agricultural belt is mostly in the zone of unstable humidity or it borders on this zone. It will be examined below.

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NAME OF PROJECT	LOCATION	AREA in HECTARES
I NORTHERN TERRITORY		
Prisukhonokaia depression	Vologda district	165,000
Komel'skaia depression - Komela and Sit' rivers	Vologda district, Griazovetskiy rayon	25,000
Kholmogorskiy swamp area	Arkhangelsk district	20,000
Pinezhskiy, Kuloyskiy and other rayons	Arkhangelsk district	30,000
Kuromskiy swamp area	North-Dvina district	15,000
Kitayskie swamps	Volga and Dvina rivers basins' water divide	20,000
Chan swamp	Arkhangelsk district, Plesetskiy rayon	20,000
Soviet farm "Polar pioneer" and collective farms in its vicinity	Karelo-Murmansk region, Louki station	18,000
II LENINGRAD REGION		
Bottom lands of the outflow of the Dolgaia and Samarka rivers	Luzhskiy district, Rudnenskiy rayon	18,000
Bottom land of the upper Sulat' river	Pskov district, Novorzhev rayon	20,000
"Giant" sovkhos and suburban dairy-garden sovkhoses	Leningrad district, Uritskiy and Detskosel'skiy rayons	50,000
Bottom land of the Sum river	Leningrad district, Kotel'- skiy rayon	10,000
Garden-dairy sovkhoses on the Sestraretsk belt railroad	Leningrad district, Porkhovskiy rayon	17,000
Collective farms of the Visherskiy rayon	Novgorod district, Visherskiy rayon	20,000
Swamps in the Polist' river basin south of Lake Il'men'	Novgorod district, Lyehkovskiy rayon	400,000
"Il'ich" kol'khos	Loydenopol'skiy district, Oiatskiy rayon	30,000
Collective farm group Onezh'e	Loydenopol'skiy district, Oshtinskiy rayon	20,000

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NAME OF PROJECT	LOCATION	AREA IN HECTARES
Yanskiy swamp area along the Yan river, tributary to the Mologa river	South of Ustinzhna - Ves'egonsk	700,000
Sudskiy collective farm group	Cherepovetskiy district, Sudskiy rayon	12,000
Zapluskiy swamp area	Luzhskiy district, Pliusskiy rayon	70,000
Collective farm group, Polianskoe and Netel'skoe swamps	Novgorod district, Chernavskiy rayon	15,000
Bottom land of the Adel and Vit' rivers	Pskov district, Kudeverskiy, Opochetskiy rayons	10,000
Soviet farm Khmelevo	Novgorod district, Starorusskiy rayon	12,000
Collective farms: "Krasny' Pogranichnik", "Vet'Issa", "Novaia Zaria", "Kr. Lebe- dinats", the Dnovskiy sovkhoz and others	Pskov district, Pskovskiy, Bezhanitskiy, Novorzhevskiy rayons	25,000
Sovkhozes: Ligovo, Lakhty, Lamy, Grivtsevo, Kolpino, Bolotnitsy and others	Leningrad district	30,000
Collective farms of the Dmitrievskie and Sokolovskie swamps	Cherepovetskiy district, Ulomskiy and Kirillovskiy rayons	10,000

III WESTERN REGION

Lovatsko-Il'men lowland, south of Lake Il'men	Velikolutskiy and Novgorodskiy districts of the Western and Leningrad rayons	800,000 (outlined 60,000)
Nerussa river valley	Bryansk district, Brasovskiy and Suzemskiy rayons	21,000
Bottom lands of the rivers Navlia, Usozh, Resseta, Nozhizdra	Briansk district, various rayons	32,000
Swampy valleys of the rivers: Os'm, Ustrom, Spriana, El'na, Berezina, Khmost'	Smolensk district, various rayons	34,000
Near-Dnepr swamp area, valleys of the rivers: Dnepr, Volost, Berezina, Mertvaia, El'ga and others	Smolensk district, Glinovskiy, Kardynovskiy rayons	52,000

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NAME OF PROJECT	LOCATION	AREA IN HECTARES
Swamp area "Zharkovsko-svitsk'y mokh"	Smolensk district, Bel'skiy Baturinskiy, Il'inskiy, Prechistenskiy rayons	180,000 (plan 30,000)
Bottom lands of rivers: Tssa, Konspliat, Los'ma, Nitsa, Loksha, Peska, Vyrovka, Chistik and others	Velikolutsk district, Sebezhiyskiy, Loknenskiy, Oktiabrskiy, Pakhomskiy rayons	32,000
Bottom lands of rivers: Mimos, Kosh, Plavenek, Log, Pressey, Dobrynia, etc.	Pzhev district, El'tsovskiy, Azhevskiy, Pogorel'skiy, Bakharevskiy rayons	16,000
Bottom land of the Sezha river	Viaz'ma district, Gzhatskiy rayon	8,000
Bottom lands of rivers: Derzh, Sadik, Ulitsa, Oleshnia, etc.	Viaz'ma district, Novodumskiy, Viazemskiy, Gzhatskiy rayons	15,000
Bottom lands of rivers: Zhizdra, Dabusha, etc.	Sukhinicheskii district, Polkhinskiy, Kozel'skiy and other rayons	12,000
Bottom lands of rivers: Minoz, Sozh, Navli, Oster, Ostrik, etc.	Roslavl' district, Stalolitskiy, Roslavl'skiy, Shumaichskiy rayons	35,000
Bottom lands of rivers Inut', Vykholski, Sudogti, Voblia and others	Klintsovskiy district, Nozybkovskiy, Starodubskiy, Gordievskiy and other rayons	28,000

IV MOSKVA REGION

Swamps at the Mologa river sources	Bezhet'skiy rayon	150,000
Bottom land of the Dubna river	Kimry district (between Sergievo and Verbilki stations of the Northern Railroad)	80,000
Bottom land of the Yakhroma river	Dmitrovskiy district	12,000
Kashin-Kalyazinskiye swamps	Towns: Kashin, Kalyazin	60,000
Swamp areas along the rivers: Gnizda, Nerskaia, Sh'e and the bottom land of the Oka river	Orehovo-Zuevskiy and Kolomenskiy districts	45,000
Petrovsko-Orshinskiye swamps	Tver' district	70,000

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NAME OF PROJECT	LOCATION	AREA IN HECTARES
Meshcherskiy forest-meadow-swamp area (Southern and Northern Meshchera) along the Priia and Oka rivers	Area between the Kliaz'ma river from the North, Oka river from the South, Yuma, Polia, Sh'ey rivers from the West and Gus' river from the East	
a) South Meschera:		
Lowland swamps gradually running into the Oka river bottom land, covered with swampy forest, meadows, pastures and fields (12%). Drainage of these swamps makes it possible to develop dairy farming (meadows) potato and flax crops, hog breeding and improvement in forest growing. For the near future reclamation of a 130,000 hectare area is envisaged.	Riazan' district	1,100,000

1) Other explorers determine Meschera as the area from the Oka river's bend beyond Dednovo village, to the Kliaz'ma river's right bank; area of 2.0 million hectares.		

V-IVANOVSKAIA INDUSTRIAL REGION

Northern Meschera, covered with bog moss (sphagnum) swamps and poor soils, represents a project of 2nd priority	Vladimir district	900,000
The Buzha and Pelia river basins	" "	16,009
Bottom land of the Unzha and Kolka rivers	" "	8,000
Bottom land of the Uved' and Suvoritsa rivers	" "	14,000
Swamp lands in the basin of the Lukh river and its tributaries	Shuysk and Kineshma districts (between Kineshma and Garokhovets)	200,000
The rivers Sit' and Yana basins	Rybinsk district	18,000
Nero lake basin	Yaroslavl' district	30,000
Bottom lands of the Solonitsa and Korba rivers, etc.	Kostroma district	10,000

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VI NIZHNIY-NOVGOROD REGION		
NAME OF PROJECT	LOCATION	AREA IN HECTARES
The Vetluga river bottom land	Nizhniy-Novgorod district	15,000
Bottom lands of rivers: Linda, Kuz'ma, Ukhta, Uzola, Ymza, etc.	" " "	10,000
The Volga and Oka rivers bottom lands (planned for the near future)	" " "	30,000
The Viatka river bottom land (Bakhchin skoe, Chashkovo, Zenzinskoe, Vodinskoe, Pikhal'skoe and other swamps)	Viatka district (Khaltarinskiy, Viatskiy, Murashinskiy, Kotel'nichakskiy rayons)	
"Gady" swamp, etc.	Viatka district	200,000
Bottom lands of the Kama and Verezhovskaya rivers (Smoky swamp, etc.)	Viatka district, Kitayskiy rayon	25,000
Swamps along the Kobra river	Viatka district, Sinegorskiy rayon	10,000
Bottom land of the Tesha river	Azhamass district, Lichde- evskiy and Azhamasskiy rayons	20,000
Bottom land of the rivers Lolan', Usia and others	Nolinskiy district	10,000

VII URAL REGION		
Tarmanskiy swamp area between the Iska and Tur rivers	Tiumen' district	300,000
Swamp area No. 1	Ishimskiy district	150,000
Maslianskiy and Tur'evskiy swamp areas	" "	25,000
Pyshtinskiye swamps	Shadrinskiy district	26,000
Swamps in the Kama river bottom land (also Kraseva and others)	Perm' district	30,000

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As to the Belorussian SSR, the total swamp area in it amounts to about 2.6 million hectares, that is 21 per cent of the entire territory of the republic, not counting the excessively humid soils among the field lands. Of this swamp area about 600 thousand hectares are peat swamps, so that for agricultural use about two million hectares should be available. It is planned to drain towards the end of the current five-year plan not less than 20 per cent of all the BSSR swamps. The largest swamp body requiring regulation and drainage is the vast group of predominantly depression swamps in the area of the Pripyat' river, between the Pripyat' river in the southwest, the Dnepr river in the east and the Zhlobin-Bobruysk-Sluts'k line. The total area is above 1.2 million hectares. During the first five-year plan in the BSSR are included the following large regulation-drainage projects (indicated are areas not exhausting the whole project, but included in the current five-year plan):

1.	Basin of the Braginka river	80,000
2.	" " " Oress " Liubanskiy and Gluskiy rayons	50,000
3.	" " " Vedrich " Rechitskiy rayon	40,000
4.	" " " Tal'ka " Pukhovitskiy rayon	25,000
5.	" " " Polota " Polotskiy rayon	20,000
6.	" " " Ukhliast' " Bykhovskiye rayon	10,000
7.	" " " Usizh-Bug " Tobchanskiy rayon	8,000

IV

Directly bordering the excessively humid soil zone is the zone of unsteady humidity. Through a number of gradual transitions, this zone runs together in its northern parts with the excessively humid zone in the southern parts - with the arid zone.

To the unsteady humid zone, the following areas partly belong: the northern and western regions of the Ukrainian SSR, the Central

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Black Soil region, the southern parts (below the Oka river) of the Moskva oblast, Central Volga region, Bashkir¹⁶ republic, southern part of the Ural region, a considerable part of Siberia, Yakutsk ASSR and Buriato-Mongolian ASSR. The water balance coefficient in the unsteadily humid zone fluctuates around 1.0, deviating in some places above the 1.0 and in others under 1.0. Accordingly we find in the zone under consideration the presence of swamps and swampy lands, but with lesser density of expansion (mainly in river valleys) per area unit, as well as areas characteristic for the arid zone: sands, ravines, lands requiring irrigation and added humidity. Consequently, the necessary reclamation leads in some cases to drainage and regulation works, and in other cases and sections, to a wide development of work on irrigation and water supply, on runoff regulation of surface waters with the purpose of supplementary soil humidity as well as prevention of erosion (reinforcing of ravines) and measures for reinforcing of sands. We shall start the examination of reclamation projects in the unsteadily humid zone in the Ukraine.

Within the borders of the Ukraine SSR, forest and forest-steppe belts belong to the zone under consideration. We have here a considerable amount of swamps and swampy lands - about 1,600 thousand hectares, mainly of transitory and lowland type, dispersed in separate bodies over the entire area (especially rich is the Korostenskiy district), but predominantly concentrated in river valleys. The swamps are rather rich, very suitable for the development of the hemp culture. The largest swamp areas in the Ukraine are the swamps in the valleys of the following rivers: Irdyn', Ros', Irpen', Teterev, Zdvizh, Oster, Smolyanka, Klaven', Tyas'nin', Supoy, Trubezh, Sula, Khorol, Zlobovka and others (Kiev, Poltava, Chernigov, Mezhin, Lubensk, Shevchenkovskiy and other districts). The total area of

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these swamps, suitable for use in the near future, is about 400 thousand hectares. Their reclamation is directly connected with regulation of the rivers mentioned. This work already has been started. During the current five-year plan it is planned to drain about 262 thousand hectares, of which 142 thousand hectares require intensive drainage.

Flooded lands should also be mentioned. These include Dnestrovokiye (between the Dnestr and Turunchuk rivers) in the Moldavian ASSR with an area up to 30 thousand hectares, the flooded lands of the Bug and the Ingul in the Nikolaevskiy district with an area of up to 20 thousand hectares.

In the Central Black-earth region the swamps and swampy lands are concentrated mainly in the river bottom lands and they cover an area of about 250 thousand hectares. Among them the bottom lands of the following rivers should be indicated: Tikhaya Sosna (12,000 hectares); Svan (8,000 hectares); Khopr (7,000 hectares); Savela (8,000 hectares); Usmanka (6,000 hectares); Bitrug (6,000 hectares); Chernaya Kalitva (5,000 hectares); and of the rivers North Donets, Vorona, Motyr', Psel, Prut, Potudan', Kiroch, Bobrovaya, Chelkovaya, Oka, Kroma, Don, Vorskla and others with a total swampy area above 18,000 hectares.

Besides the drainage work, large water supply works have to take place here on the lands of the sovkhoses and collective farms and Machine-Tractor Stations; for the near future, these works are outlined over an area of about 850 thousand hectares. Irrigation will be necessary here also, mainly for vegetable crops and partly for meadows; total area about 100 thousand hectares.

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In the Central Volga region, as in the preceding one, reclamation of both kinds - draining and water supply - irrigational - have to take place. The largest areas indicated for drainage and other reclamation work are the following:

- 1) the Sura river basin (Kuznetskiy, Penzenskiy, Syzranskiy, Ul'yanovskiy districts and A.M.O.), an area of about 50 thousand hectares;
- 2) the river Moksha basin (Penzensk district and A.M.O.), an area of about 40 thousand hectares;
- 3) the Cheremshani' river basin (Ul'ianovskiy district), an area of about 33 thousand hectares.

As to the water supply and irrigational reclamation work, such will take place mainly in the Trans-Volga arid part of the region, in the Samara, Buzuluk, Drenburg and other districts. We shall talk below about these reclamation projects.

A considerable part of Siberia and the Far-Eastern region, specifically most of its agricultural belt, is in the zone of variable humidity. Besides the very large areas of swamps and swampy lands which are within this belt (according to very approximate calculations, more than 10 million hectares), there are also quite large steppe areas of distinctly arid climate which have to be watered and irrigated. Further on, we shall indicate the largest reclamation problems of draining and irrigation in Siberia and the Far-Eastern region which now are standing out more or less clearly in connection with agricultural reconstruction. The realization of these projects will make it possible to create meadow lands and to develop animal husbandry, flax industry, grain and technical crops, and will also facilitate the cultivation of rice (Far East region).

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To solve these problems, it will be necessary to carry out vast projects to regulate rivers, to strengthen banks and protect low areas from floods (Far East region), to drain, and in places irrigate sovkhoz and collective farm areas. These are large problems and still they do not cover all the possibilities of this region. During the current five-year plan for Siberia and the F.E.R., some of these problems already have been tackled, but so far, on a small scale. The entire reclamation area in Siberia during the first five-year plan consists of 650 thousand hectares for draining and about 100 thousand hectares for irrigation. The following are the largest Siberia and F.E.R. draining problems:

Barabinskiy swamp area, part of the basins of the Irtysh river (Om', Tara) and Lake Chan (Chulym, Kargat rivers and others)	Novosibirskiy and Barabinskiy districts	4,000,000
Vasyuganskiy swamp area	Naryn region	1,000,000
Rybino-Kargalinskoye area bordered by the Irtysh, Ishim, and Om' rivers	Tarskiy and Tshimskiy rayons	2,100,000
The river Ob' bottom land (total area 1.8 million hectares)	Biysk, Barnaul, Novosibirsk districts	350,000 (in the butter industry rayon)
Swampy land areas along the rivers: Zeya, Nara, Selendzha, Tom', Urga, Tu, etc.	Far East Region	400,000
Primorskiy rayon. Basins of Lake Khanka, of Ussuri, Iman, Van, Khor, Bikin and others	" " "	600,000
Biro-Bidzhansk rayon. Basins of river Amur and its tributaries Ik, Bira, Datur, Bidzhan, etc.	" " "	800,000

The largest of the irrigational projects outlined at the present time are the following:

- 1) Irrigation of the Koybal'skaya steppe (southern part of the Abakan-kayoe steppe) situated between the Abakan and ^{Ye} Enisey rivers (Minusinskiy district, Bemskiy rayon), on an area of 60,000 hectares.

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tares, on 10,000 hectares of which irrigation work is being done at the present time with the waters of the Uya river.

- 2) Irrigation of the Aleyskaia steppe from the Aley river (Rubstovskiy district) on an area up to 22,000 hectares.
- 3) Irrigation of the Iyusskaya and Uibatskaya steppes of the Khakas-skiy district, with a total area of 45,000 hectares.

The majority of these systems allow the introduction of valuable technical crops; for example, sugar beet.

In the Buryato-Mongolian ASSR, in the zone of irregular humidity, there are also considerable areas which in order to be used need drainage as well as irrigation. We shall indicate the following as the largest of the draining projects outlined at the present time:

- 1) Keymarskiy swamp area, Tunkinskiy rayon (10,000 hectares).
- 2) Kabanskiy swamp area along the ^{Ye}/_g Klavka, Zagda, Dulan, Tomly'y, Ogmur and other rivers of the Kabanskiy rayon (16,000 hectares).
- 3) Itantsingskiy swamp area along the Itantsa river. Verkhneudinskiy rayon (8,000 hectares).

Among the irrigation projects we shall indicate:

- 1) In the Selenginskiy rayon in the Selenga, Dzhida, Khilka, Sulkhari, and Iro rivers valleys, on an area of about 10,000 hectares.
- 2) In the Kiakhta rayon, in the Chikoy river valley, about 10,000 hectares.

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The zone of variable humidity gradually becomes the arid zone of insufficient humidity. This latter zone covers a vast area in the

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USSR. It includes the southern part of the Ukrainian SSR, Crimean ASSR, the left bank part of the Central Volga region, Lower Volga region, North Caucasus region, the Dagestan ASSR, the Trans-Caucasus SFSR, the Kazak ASSR, the Turkmen SSR, the Uzbek SSR, the Tadzhik SSR, and finally the Kirghiz ASSR

The water-balance coefficient in this zone everywhere is below unity, and therefore, we have here a number of very characteristic hydrological conditions -- a sparse hydrographic system, low water level in the rivers, deep ground waters which are quite saline, dryness of soil and in many cases the development^{of}/processes which make them saline. Soil erosion develops and soil is blown away, with the formation of ravines and unstable sands. However, the water balance on all of this vast territory of inadequate humidity varies considerably,-- from 0.7-0.6 in the zone's northern sections (for example, Northern Ukraine), to 0.05 in its extreme south and southeast sections (for example, many parts of the Turkmen SSR). Corresponding to the range of fluctuation of coefficient of water balance, and the degree to which all of the above indicated hydrological conditions are present, the degree of aridness and extent to which there is urgent need of additional moisture in this zone, varies greatly. In some sections, irrigation is necessary only during certain arid periods or for certain very valuable crops which need a lot of water. In other sections, irrigation is a basic prerequisite for any type of farming.

In some places, due to the composition of purely local conditions, we also have here excessively moist lands; for example, the sedimentary lands in river deltas (Kuban', Dnepr, Don, Volga), the swampy lands of the Black Sea shore, and others located in southern climactic conditions; and because of this, in most cases, very valuable

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land.

The total area of lands whose reclamation needs a supply of water and irrigation in the entire arid zone of the USSR is very large, and is measured in tens of millions of hectares. Here, however, we come up against conditions common to arid countries: there are considerably more lands requiring irrigation and suitable for it, than there are water supplies which could be used for this irrigation. Existing water resources and their irrigational capacity represent here the limits to which irrigation can be developed. Therefore, irrigation projects have to be studied starting with the irrigation possibilities of individual irrigation sources, insofar as we have data on these. But, unfortunately, on many of them the necessary data is not available. The second limiting factor for reclamation projects in the arid zone will be the suitability of soils for irrigation and agriculture in connection with their hydrology, topography, salinity, etc. In this regard, we are far from having the necessary data, particularly for those indicated projects for which detailed exploration has not yet been accomplished. Therefore, the figures given below on irrigated areas in most cases are only tentative, rough ones, which have to be made more precise as a result of adequate research and study.

We shall start the study of reclamation projects in the arid zone of the USSR, commencing with the Ukraine. The steppe belt belongs to the arid zone of the Ukraine SSR. This, in turn, may be divided into two basic parts along the line of Berdiansk, Zaporozh'e, Zinov'evsk. The northern part is mainly subject to local irrigation, while the southern section makes more demands upon national irrigation. The following rivers serve as sources of irrigation in the Ukraine: Dnepr,

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Bug, Ingul, Ingulets, Volch'ia, Samara, etc. At the present time the following principal irrigation projects are indicated for the Ukraine (first priority):

1) In the Dnepropetrovsk and Zaporozh'e sections, from the Dnepr river, from the upper water of the Dneprostroy dam, 23,000 hectares on the left bank and 45,000 hectares on the right bank can be irrigated - total about 68,000 hectares.

2) From the Dnepr tributaries discharging into the upper water along the left bank, the irrigation of the following areas is possible: 5,000 hectares from the Kil'chen river; 40,000 hectares in the Pavlogradskiy rayon from the Volch'ya Samara river; and about 37,000 hectares from the Volch'ya and Tersa rivers.

3) From the lower water of the Dnepr dam and the tributaries discharging below the dam, it is possible to irrigate the following areas:

	<u>Hectares</u>
a) on the left bank:	
from the Malaya Moskovka and Kouskaia rivers.....	9,000
" " Belozerka river.....	12,000
" " Rogachki and Gornostaevka rivers.....	15,000
b) on the right bank:	
from the Tomalovka river.....	17,000
" " Saksagan' (Krivorozh'e) river.....	31,000
" " Solenaya (Nikopol', Krivoy Ruz) river....	64,000
" " Ingulets river.....	17,000
" " Dnepr - from Nikopol' to Kakhovka.....	6,000
In the Kherson rayon.....	17,000
	Total 188,000

4) Irrigation of the lower Dnepr's left bank steppes, - gross area 600,000 hectares (net - 480,000 hectares) - by way of a mechanical

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raising of the Dnepr river water through the facilities of the pumping station at Kakhovka, which obtains energy from two lower hydro-electric stations (Nikopol' and Gornostaevka)...(secondarily, from Dneprostroy).

5) Irrigation of the right bank steppes in the Kherson-Nikolaev region; total gross area about 120,000 hectares.

6) Irrigation from the Southern Bug; total gross area about 160,000 hectares of which 115,000 hectares are on the left bank and 45,000 hectares on the right bank.

7) Besides these areas, irrigation is indicated in the Donbas area from nearby rivers and streams on an area of about 25,000 hectares. In the Khar'kov rayon the Lopan', Uda, Donets, and Vorskla rivers should irrigate an area of about 17,000 hectares; in the Melitopol' rayon from the Molochnaia, Berda and Kal'mius rivers, an area of about 8,000 hectares; in the Moldavia^{an} ASSR, an area of about 75,000 hectares; and in the Kremenchug rayon of Poltavshchina, an area of about 5,000 hectares.

With all the sources mentioned it is planned to irrigate about 300,000 hectares during the current five-year plan.

In the second place, irrigation in connection with the Dneprostroy should include the irrigation projects of the higher areas between Kakhovka and Nikopol':

- a) on the left bank - about 500,000 hectares
- b) on the right bank - about 200,000 hectares.

But these problems are yet entirely unexplored and represent also considerable technical difficulties in terms of having enough Dnepr water (building of reservoirs).

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etc. and 3) production of a considerable amount of hydro-electric power. This will be achieved by the joint impact of the following measures: establishing of regulatory reservoirs on the upper part of the river; building canals for irrigation and water supply; carrying off part of the flood waters into the sand and reinforcing the lower river area. Without regulation of the runoff, the Terek river is capable of irrigating about 900,000 hectares. By regulating the runoff with reservoirs, it will irrigate up to 1.3 million hectares (obtaining besides that, about one million kilowatts of hydro-electric power). The entire Terek problem is being worked out now, but part of the water supply and irrigation systems is already underway. The Alkhanchurskaya system can supply 175 thousand hectares with water, irrigating 18,000 hectares. The Malo-Kabardinskaia irrigation system would be able to supply water to 65,000 hectares, irrigating 33,000 hectares. The Tersko-Smirnovskiye canals should irrigate 100,000 hectares and supply water for 1,000,000 hectares. Then there are the Kumskiye and Sunzhenskiye canals.

In connection with the Terek river problem there is also the problem of using the Sulak river (Dagestan Republic), which, in addition to hydro-electric power, can irrigate an area of 150-200 thousand hectares.

In Dagestan also, the problem of using the Samur river should be pointed out. Its irrigation capacity is about 20,000 hectares; and the smaller streams in the Derbent (Terekomeyskaya and Rubasskaya systems) Kizlyar, Babaiyurtovskiy districts.

Use of new sources and reconstruction of old native systems will make it possible to increase the cotton area to 75-80 thousand

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hectares (instead of the 17,000 at present), and the ^{kenaf}~~subirrigation~~ area up to 25,000 hectares.

It is further necessary to indicate the large problem of land irrigation in the Sal'skiy district, from the Sal river over an area of 100,000 hectares (regular and also estuary irrigation).

The next largest problem, up to now little known and requiring adequate exploration, - is the Manych problem. It specifies the construction of a navigable-irrigation canal along the Manych river valley, connecting the Black Sea with the Caspian Sea. On the upper section, below the water divide of the canal, with the aid of two dams, a tremendous reservoir will be built. Water will be fed to the canal from the flowing surface waters of the Stavropol' plateau as well as by canals leading from the Kuban' and the Don Rivers. The carrying out of this project will make possible⁽¹⁾ the irrigation of about 1.5 million hectares in the lower Don area - 150,000 hectares; from the mouth of the Manych to Proletarskaia - 150,000 hectares; on the canal's southern slope - 600,000 hectares; and in the Kalmyk oblast - 600,000 hectares, making these areas available for the production of alfalfa, gambo hemp, cotton, tubers and other crops; and ⁽²⁾ the attainment of about 160 thousand kilowatts of hydro-electric power at the dams; and finally, this development will be of enormous importance to transportation.

Besides these large irrigational problems, there are in the North Caucasus: 1) problems of water supply for almost all the territories of the region; ponds, artesian and shaft wells must be built when organizing sovkhoz and collective farms. The total area requiring such water supply measures about 30 million hectares; and 2) smaller irrigation problems; as, for example: a) the Kalaus river

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valley irrigation (Stavropol' district), an area of 25,000 hectares;
 b) water supply through the Digorskiy canal (North Osetiniya), a
 40,000-hectare area; c) irrigation of a 20,000-hectare area in the
 Ust'-Medveditskiy rayon; d) irrigation of 100,000 hectares in the low-
 er Don river area, lands suitable for valuable garden-orchard crops,
 rice, etc.

Besides the irrigational problems in the North Caucasus, we
 have also a number of drainage problems. The largest problems of this
 kind in the North Caucasus are the drainage problems of the naturally
 very valuable but swampy lands - Kubanskiye, Priazovskiye and Adygeyskiye
 flood lands, and Aksayskiye and Donskiye lands flooded in the spring.

The total area of the Trans-Kuban' lower left bank (from the
 Afips river 15 kilometers from Krasnodar to Varenikovskaya station) is
 about 200,000 hectares, of which 65,000 hectares are subject to first
 priority reclamation. The total area of the ~~Trans-Kuban'~~ Azov lowlands, located
 on the river Kuban's right bank between the Kuban', the Sea of Azov
 and the Protoka river - is above 600,000 hectares, of which 100,000
 hectares are marked first priority for reclamation. In the Adygeyskiye
 lowlands 50,000 hectares are indicated for reclamation. The essence
 of lowland reclamation amounts to regulating the flow of ^{the} Kuban' and
 Protoka rivers, and of the mountain streams which empty into the Kuban'.
 It involves draining swampy areas, protecting them against future
 floods, and providing necessary irrigation. Rich lowlands can be used
 for rice, ^{kenaf} ~~vegetable~~, vegetable, orchard and grain crops.

The Aksaysko-Donskoye lowlands represent a swampy area on the
 shores of the Don river and its tributaries, the Aksay, Tuzlovka, etc.,
 which is flooded yearly by the spring waters of the Don and Aksay. The
 flooded lands are now being used as inferior hay-cutting meadows. They

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are sources of malaria for Rostov, Novocherkassk, and Azov. Reclamation of the lowlands, repairing the banks, drainage and irrigation will make it possible to use them for valuable vegetable and berry crops, rice, etc.

First priority is indicated in reclamation of flooded land on an area of 80,000 hectares, under conditions which tie in the interests of both agriculture and the fishing industry.

Further, drainage of the Instisunskiy swampy land in the Gundermesskiy district should be indicated. This is a total area of 40,000 hectares located between the Terek river on the north, the Belaya river on the west and spurs of the Caucasus mountains on the south.

There are large swamp areas which need draining in the Dagestan ASSR. Among these, attention should be given to: 1) regulation and draining in the lower Aksay and Aktash rivers - an area of 20,000 hectares; 2) draining the swamps at the Kargalinskiy gap over an area of 60,000 hectares; and 3) regulation and draining at the lower Samur - about 6,000 hectares.

We shall turn now to reclamation problems along the Volga. The largest problems here are those of irrigation in the Central and Lower Volga regions.

In the Central Volga region the irrigation of a total area of 1.3 million hectares is envisaged, by the use of local streams as well as the Volga itself. The main irrigation projects indicated are: Donguzskiy and Kinel'skiy from the Ural river - about 100,000 hectares; Tlek'skiy, from the Tlek river - about 100,000 hectares; Volzhskiy (both north and south of the Volga river) - about 800,000 hectares; and the

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remainder from the Samarka river (about 65,000 hectares), Salmysh, Chernaya and other rivers.

The largest reclamation problems and objects in the Lower Volga region are the following: First, there is the problem of extensive Trans-Volga irrigation. This problem specifies the irrigation of the Trans-Volga steppes with the Volga river water raised partly by powerful pumping stations into large reservoirs from which, over a main canal system, the water is distributed over the area to be irrigated; and partly supplied through a naturally-flowing canal.

This problem is closely connected with the Greater Volga problem; that is, the construction on the Volga of a series of multi-purpose dams (for power, irrigation and transportation). Depending upon one or another variation in how the Greater Volga problem is worked out, and how irrigation problems are decided, this will lead either to: 1) greater emphasis on mechanical water-raising versus gravity; or 2) the location of the irrigated land areas - either predominantly in the Syrt section or in the Caspian depression. According to the main variations, irrigation from the Volga river is possible over a total area of 10 - 12 million hectares on the left bank and up to 1.0 million hectares within the boundaries of the Kalmyk oblast. Use of the irrigated lands is envisaged for wheat, alfalfa, sugar beets and other crops. In this connection, the main purpose is: 1) to obtain a reliable wheat supply; and 2) to establish a reliable irrigated source of fodder so as to develop animal husbandry in the region.

The next large problem is the ^{ye}Argeni-Sarpinskaya problem which specifies water supply (300,000 hectares) and irrigation (100,000 hectares) in the northern part of the Kalmyk steppe, with the use of the

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local flow of the ^{ye}Argeni streams as well as the water raised mechanically from the Volga river.

Further, there is the reclamation problem of the Volga-Akhtubinskaya flooded land and delta, with work on the banks indicated, together with drainage and irrigation of a total area of 800,000 hectares of valuable lands subject to floods by the Volga. These lands could be used for growing vegetables and technical crops such as gambo hemp, cotton, and rice. This problem is being worked out now and its solution will require an integration of the interests of both agriculture and the fishing industry.

Besides the mentioned reclamation problems, there are in the Lower Volga region a number of smaller irrigation projects, of which we shall indicate the following: 1) irrigation of 10,000 hectares from the Khopr river in the Mikhaylovskiy rayon; 2) irrigation of 15,000 hectares from the Medveditsa river in the Medveditskiy rayon; 3) irrigation of up to 18,000 hectares from the Ilovliya river in the Kamyshin rayon; 4) irrigation of 10,000 hectares in the Krasnoarmey-skiy rayon; 5) irrigation of the 15,000-hectare steppe strip of the Akhtuba river; 6) irrigation from the Balanda river in the Atkarskiy district; and 7) irrigation of up to 11,000 hectares on lands in the maritime strip of the Kalmyk and other regions.

Among the reclamation tasks in the Lower Volga region (as in many other arid areas), of greatest importance is the supplying of water to sovkhoses and collective farms which grow grain and raise livestock. This is done by making ponds and digging wells, and also by undertaking to regulate and direct the use of local streams of surface waters - building inlets to retain water, and ways to retain moisture by holding back both snow and water. Proper carrying out of

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these measures will make it possible to use considerable areas of lands not being used at the present time.

The Uralo-Kushumskaya problem of Kazak^hstan, as to its natural and technical conditions, is closely related to the problem just examined. The plan being outlined at the present time specifies the building of a dam on the Ural river at the village of Kushumskiy. This is to ensure a regular flow of water from the Ural to the Kushum, regardless of the spring flood water level in the Ural. An 8,400 h.p. hydro-electric station is to be erected at the dam. The areas to be irrigated are along the Kushum, from Kolovertinskiy village to ~~Kuznetsov~~ ^{Bolsheoy} Uzen'. Farther, the water is conducted into the Ashche-Say ravine and the Solianka river, expanding the irrigated area into the Ulektinskiye flood area and into the Baigutinskaya depression. Besides that, the steppe rivers of the Kamysh-Samarskaya depression (Uzen', Dyur, ^{side} etc.) are used for estuary irrigation - that is, from the right/of the Urals. Also, the Baygutinskaya depression rivers are used, but on the left side of the Urals. Due to the flooding of the Kushum river bed, the water level in the Kamysh-Samarskiye lakes also rises, which makes for better fishing. The entire irrigation area, according to the outline, is about 800,000 hectares, of which 300,000 hectares are regularly irrigated and 500,000 hectares are irrigated from the estuary or "liman". According to sections, these areas are distributed as follows: in the Uralo-Kushumskiy sector - 300,000 hectares regular and 200,000 hectares "liman" irrigation; in the Kamysh-Samarskaya depression - 212,000 hectares "liman" irrigation; and in the Barutinskaya depression - 93,000 hectares "liman" irrigation. The irrigated area will be used for technical crops, vegetables, grain crops and grasses (mainly in the "limans"). In the southern parts of the irrigated areas,

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rice and cotton crops are planned. The realization of this project will allow us to ^create a reliable supply of fodder, making it possible to have animal husbandry here on sovkhozes, and making it possible to reconstruct the farming of the Ural region.

In Kazak^hstan and North Kirgizia large irrigation tasks are those connected with the building of the Turkestan-Siberia railroad, and the problems of the Kuzbas, Karaganda and other areas. It can be assumed that, with the maximum use of existing water sources suitable for irrigation in these areas, the irrigated section in the Turksib sectors can be expanded from the present 500,000 hectares to about 2.3 - 2.5 million hectares. The largest irrigated area increase will be in the Dzhetyysuyskaya (1.4 - 1.5 million hectares) and the Semipalatinsk district (0.4 - 0.5 million hectares), Kazak^hstan and North Kirgiziya (0.3 - 0.4 million hectares).

The construction of the Turkestan-Siberian railroad opens wide possibilities for the development of irrigation. Further, we shall indicate the main possible irrigation projects which are already studied one way or another, and for which there already exist suggestions of one kind or another. We shall do it according to the main river basins.

1) In the Irtysh river basin, according to the amount of water in it, the irrigation of several hundred thousand hectares is possible, but this question has not been considered yet. It is planned to irrigate only the lands around lake Zaysan, using water from the Irtysh tributaries. This would include the Kal'dzhir, Kurchum and other rivers. Specifically, in the Kal'dzhir steppe, along the Kal'dzhir river's right and left banks, it is possible to irrigate an area of 42,000 hectares. Here it is possible to cultivate grains, alfalfa, and sugar beets.

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2) In the Il' river basin it is possible to irrigate considerable areas. The Il' river's irrigation capacity can be assumed as being about 1.2 million hectares. The actual area which it irrigates at present is about 250,000 hectares. Due to the insignificant grading of the Il' river within the borders of the USSR, getting water out of it presents certain difficulties. In building the canal head inside of China, gravity irrigation is possible on the left side of the valley covering an area of 200 - 800 thousand hectares (different estimates for different schemes) of new lands up to the Charyn river and within the Union's borders. Further, it is possible to utilize for irrigation the Il's tributary, the Charyn river (Kayen' river). Its irrigation capacity, if a reservoir were built, would be about 100,000 hectares of good, elevated lands of the Il' valley.

On the left side, - from the border to the community of Iliyskoye, it also is possible to have mechanical irrigation (for example, on rice plantations). There are also considerable land areas for irrigation in other, mainly lower sections of the Iliyskaya valley (rayon of the Bakan meadows with an area of up to 1,000,000 hectares). Irrigation is possible also from other Il' river tributaries; for example, the Chilik river and others. Besides using these tributaries for irrigation, they can give considerable amounts of hydro-electric power (over 1,000,000 horsepower), which can be used to raise the water mechanically from the Il' river in order to irrigate the lands of its valley. The Il' valley lands can be used for growing rice, sugar beets, alfalfa, grain crops and fruits (in the more elevated sections of the valley).

- 3) Among other rivers of the Lake Balkhash basin, we shall mention:
- a) the Karatal river, from the Central section of which it is possible to use the water for irrigating an area of 80,000 hectares;

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- b) the Bien' and Aksu rivers, where it is possible to irrigate 50,000 hectares of new lands;
- c) the Lepsa river and its tributaries which could be made to irrigate about 40,000 hectares.
- 4) The Tentek river, which waters the vast Alakul'skaya valley, with proper exploitation could be made to irrigate, in addition to already irrigated lands, another 80,000 hectares. This area is suitable for the development of grain crops (but not rice) and alfalfa.
- 5) The Chu river which flows through a valley between the Aleksandrovskiy range and spurs of the Trans-Iliyskiy Alatau, has a good climate. According to the project outlined, making use of six separate systems, it could irrigate a total of about 270,000 hectares of lands suited to valuable crops: ^{kenaf}~~gambel hemp~~, ^{kendyr}~~Indo-China hemp~~, rice, grapes, alfalfa, sugar beets, fruit trees, early-ripening varieties of cotton. The project already has been started, in part. The construction of a dam and reservoir will make it possible to get about 200,000 horsepower of hydroelectric power, which can be used widely by agriculture and industry.
- 6) In the Aul^eiatinskiy section, it should be mentioned that it could be possible to increase the irrigation in the Talas river basin by more than an area of about 40,000 hectares (in Kirgizya and Kazak^hstan).
- 7) In Central Kazak^hstan there are large problems of using the runoff ^{area} of the steppe rivers for "liman" and regular irrigation of a total of 1,000,000 hectares. The main irrigated areas can be obtained from the following river systems: Uil (70,000 hectares); Turgay (up to 180,000 hectares); Irgiz (57,000 hectares); Sary-Su (up to 200,000 hectares); Nura (up to 215,000 hectares); and others.

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8) In the north of Kazakhstan, there is a large problem of watering enormous waterless areas in the Akmolinsk district, areas lacking both ground and artesian water, or even surface reservoirs. The area of such lands, quite suitable for agriculture, exceeds 2,000,000 hectares. Among these lands, three main areas should be mentioned: a) in the Chaglinskiy rayon about 500,000 hectares; b) between the Nura, Dengiz and Ishim rivers - 700,000 hectares; c) west from the Ishim, between the Ishim river and the former Turgayskaya region - about 800,000 hectares. The water supply of these lands is possible only by way of canals deriving the water from the nearby Ishim, Chaglinka and other rivers, with the construction of dams and reservoirs on these rivers.

We shall turn now to the cotton areas of Central Asia. The unoccupied land reserves are concentrated here in the basins of two main rivers: Syr-dar'ya and Amu-dar'ya. Along these river basins we shall examine the main aspects of irrigation development.

1) Fergana. The exploitation of the Naryn, Kara-dar'ya, Isfary, Sokha Ak-Bura and other rivers, feeding this section, - under the condition that their flow would be regulated: This makes it possible to irrigate an area of about 1.3 million hectares; at the present time the irrigated area consists of about 900,000 hectares, so that one may speak of an increase of about 400,000 hectares, [of which about 100,000 hectares fall to the ^Syr-dar'ya and the Naryn and the rest to the rivers starting in the Fergana proper.] Suitable lands are among the existing systems (fallows) as well as among new lands. The extension of irrigation has already begun: Uch-Kurganskaya steppe (20,000 hectares); Yangi-Arykskaya system (25,000 hectares); Ak-Burinskaya system (20,000 hectares); Kuygan-Yarskaya system (47,000 hectares); Savayskaya steppe

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(9,000 hectares); Nizhniy Khann (13,000 hectares); Narpay (9,500 hectares); etc.

2) Golodno-steppe rayon. It has about 750 - 800 thousand hectares of lands suitable for irrigation: Dal'verzinskaya steppe - about 45 thousand hectares; Golodnaia steppe proper - about 530,000 hectares; Nuratinskaya steppe - about 150,000 hectares; and Chardarinskaya steppe - about 50,000 hectares. Irrigation of all these lands is possible from the Syr-dar'ya river. Irrigation of the Dal'verzinskaya steppe is already nearing completion. For the Golodnaia steppe, an irrigation project is outlined for 405,000 hectares, [of which 70,000 hectares will be irrigated without the building of new head structures.] ³⁵⁴⁰ In the Chardarinskaya steppe - irrigation of 21,000 hectares (first section). According to the exploitation plan of the Syr-dar'ya river, the increase of irrigated land in this region is seen as amounting to 535,000 hectares.

3) Chirchik-Angrenskiy rayon irrigated by waters from the Chirchik, Angren, Keles and Kuru-Keles rivers has at the present time an irrigated area of about 240,000 hectares. After the regulation of their flow by building reservoirs, the entire irrigation capacity of these rivers will be about 725,000 hectares. First of all, it is planned to make use of the Chirchik river water. Its irrigation capacity after the building of the Chatkal'skiy reservoir will be about 490,000 hectares, so that the increase of irrigated areas, as compared with areas now irrigated in the Chirchik basin, will amount to about 310,000 hectares.

4) Otrar'skiy rayon - between Chimkent and Turkestan - represents a plains area of Syr-dar'ya and Arys' rivers. The area suitable for ir-

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rigation consists of about 350-400 thousand hectares, of which about two-thirds are suited to cotton growing. This is the limit to the region where cotton can be cultivated.

5) Farther, comes the vast section of lower Syr-dar'ya and its delta, with an area of 1,000,000 hectares of lands suitable for irrigation, but not for growing cotton, since it lies above the 43d degree north latitude. According to the preliminary plan for exploiting the Syr-dar'ia river in this rayon, the irrigation of some 250,000 hectares is foreseen. For the irrigation of all the suitable lands in the lower river region, there might not be enough water in the Syr-dar'ya river and the question might arise as to the transfer of water from other sources (for example, the Il' river), but these problems are not yet being worked out.

Thus, it is possible, by utilizing the river itself and its tributaries, to expand the irrigated area in the cotton zone of the Syr-dar'ia river basin by about 1.6-17. million hectares. This could be accomplished by regulating the flow of water for many years by the building of reservoirs.

We proceed now to the prospects of irrigation development in the Amu-dar'ya basin. The total irrigation capacity of the Amu-dar'ya river can be estimated as at about 4,000,000 hectares (without flow regulation) and up to 5,000,000 hectares with regulated flow. (Engineer Tsinzerling determines Amu-dar'ya's irrigation capacity as 1,500,000 hectares above the now irrigated area. Such is his distribution of free amounts of water: the existing irrigation - 360,000 hectares; upper river area - 385,000 hectares; lower river area - 1,300,000 hectares.) The irrigated area in the Amu-dar'ya basin is about 1,300,000 hectares. The following are the main rayons and areas

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of the existing and future irrigation development indicated in the plan now being worked out:

A. Upper River SectionLands along the Banks

1) Surkhan-Shirabad ⁵ kiy	-	300,000 hectares
2) Kafirniganskiy	-	120,000 "
3) Vakhshskiy from lake Aral	-	130,000 "
4) Pandi-Kuliabskiy	-	80,000 "

B. Central River SectionLeft BankRight Bank

1) Kerkinskiy -	36,000 hectares	1) Khadzhayanskiy -	27,000 hectares
2) Ersarinskiy -	34,000 "	2) Farabskiy -	14,000 "
3) Chardzhuyskiy -	37,000 "	3) Burdalykskiy -	9,000 "

C. Lower River Section

1) Shurakhanskiy	-	140,000 hectares
2) South Khorezmskiy	-	400,000 "
3) Kunya-Dar'inskiy	-	297,000 "
4) Kungrad-Khodzheyliński	-	140,000 "
5) Ishan-Dzhekanskiy	-	70,000 "
6) Chimbayskiy	-	187,000 "

Lands of the Trans-Caspian Rayon
(Kara-Kumskiy Canal)

1) Kara-Kyl'skiy oasis	-	40,000 hectares
2) South-Eastern Kara-Kumy	-	60,000 "
3) Mervskiye and Murgabskiye low-lands	-	260,000 "
4) Tedzhenskiy oasis	-	240,000 "
5) Other areas	-	460,000 "

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The following are outlined as first priority projects: irrigation of the Vakhsha river valley (100,000 hectares); reorganization of South Khorezm's irrigation (possible increase of irrigated area, about 130,000 hectares); irrigation development in the Kunya-Dar'inskiy rayon (increase of about 200,000 hectares); irrigation reorganization in the Ersarinskiy rayon (increase 36,000 hectares) and others. Bringing water from the Amu-dar'ya river to the Trans-Caspian region is a second priority task.

There are large reclamation tasks in Central Asia; also in the Zeravshan and Kashka-dar'ya river basins. With the flow regulated by reservoirs and the water distributing junctions rebuilt, the possible irrigation area in the Zeravshan basin is estimated, in terms of the scheme worked out, as about 600,000 hectares. [This will represent an increase of about 100,000 hectares of irrigated land, in this basin.] 354P

By reorganizing the system and building two reservoirs - on the Kashka-dar'ya and on the Guzar rivers - the irrigated area in the Kashka-dar'ya river basin can be raised to 110,000 hectares, which will be an expansion of approximately [50,000 hectares above the present irrigated area.]

It is necessary, however, to make a reservation by saying that all the mentioned area figures are only approximate estimates, since for many projects the necessary explorations and studies have not yet been made, and there is no precise data on either water supply or land characteristics.

Thus, by carrying out adequate irrigation -- hydrotechnical projects guaranteeing the proper use and regulation of the flow of the existing rivers -- the irrigated area in Central Asia which now covers about 3,400,000 hectares could be tripled; that is, it could reach

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10,000,000 hectares, of which 8,000,000 hectares would be located in the cotton belt.

Toward the end of the current five-year plan, it is planned to bring the irrigated area in Central Asia up to 4,500,000 hectares, of which increase of about 1,000,000 hectares will come from both large-scale developments (650,000 hectares) and from small-scale developments (500,000 hectares).

We shall turn now to the Trans-Caucasus SFSR. The prospects and possibilities for reclamation work here are quite considerable. The basic kind of necessary improvement is irrigation. At present the irrigated area in the Trans-Caucasus SFSR is about 900,000 hectares (1.2 million hectares with applied water). But in a number of rayons there are swampy lands (their total area about 250,000 hectares), and drainage is needed.

The basic reclamation problem here is that of using the reserve supplies of water and land in the Kuro-Araksinsk basin. The irrigation capacity of these rivers (Kura and Araks) together is about 2,000,000 hectares. The land reserves considerably exceed the irrigation possibilities. The preliminary plan for using water of the Kuro-Araksinskiy basin indicated the following plan for use of the Araks river water:

	(a) without flow regulation	(b) with flow regulation
Muganskaya steppe	175,000 hectares	290,000 hectares
Mil'skaya steppe	11,000 "	185,000 "
Persian Mugan'	49,000 "	70,000 "
Total	235,000 "	545,000 "

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The area irrigated in the Mugan' at the present time represents about 50,000 hectares, so that the increase will consist of 120-235 thousand hectares. During the Five-Year plan it is intended to bring the irrigated area in the Mugan' up to 90,000 hectares. The irrigation of the Mil'skaya steppe is also started. The irrigation system imini comrade Ordzhonikidze (the Gyar-Arkh canal) is being built to irrigate 33,000 hectares. As to the Kura river, its irrigation potential is determined - without flow regulation - as a total of 500-600 thousand hectares. This includes the Shirvanskaya steppe (about 340,000 hectares), the Mil'skaya steppes (about 150,000 hectares), and the Sal'ianskaya steppe (about 50,000 hectares).

All these calculations are being more accurately defined at present by the "Zakvodkhoz" Trans-Caucasus Water Works. These are the largest problems of the Trans-Caucasus. There are, besides, a number of smaller but very important projects representing the utilization of smaller water sources, some of which as yet are not in use at all, and some of which are not fully used. By regulating the flow and reconstructing the system of these sources, their watering potential can be increased. The flow regulation of the Trans-Caucasus rivers is especially necessary, because the majority of them have a maximum discharge during April-May which is not suitable for watering crops like cotton, rice, fruit trees, etc. Among these projects, the following should be mentioned:

- 1) Development of irrigation from the Terter river (Azerbaijan). Regulation of its flow by building reservoirs will make it possible to bring the irrigated area up to 80,000 hectares, as against the present 40,000 hectares. Also, it will represent an increase in the percentage of cotton grown from 25 per cent to 50 per cent.

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2) Kara-Sakhkal'skoye irrigation from the Kura river over an area of 11,000 hectares (Azerbaijani).

3) Irrigation from the Alazan' river in Georgia of an area of 45,000 hectares. The work being carried out.

4) Irrigation from the Iora river in ^(Georgia) ~~Georgia~~: The irrigation potential of this river is about 100,000 hectares, located near Tiflis (irrigation of the Samgor'). In its lower reaches, it is suggested that this river can be used to irrigate 15,000 hectares in the El'darskaya steppe.

5) Irrigation reconstruction in the Tiriponis-Veli valley ^{Georgia} ~~(Georgia)~~ from the Liakhva river: total area about 29,000 hectares, of which 15,000 hectares is on new lands.

6) Irrigation reconstruction in the Sardarabad (Armenia) area from the Araks river -- total area about 22,000 hectares, of which 7,000 hectares are on new lands. The work is going forward.

7) Irrigation of Kirov from the Zanga river, whose source is Lake Sevan (Gokcha): area about 45,000 hectares. The use of waters of Lake Sevan (Gokcha) will make it possible not only to obtain a considerable amount of hydro-electric power, but also to enlarge the irrigated area.

Toward the end of the current Five-Year Plan it is intended to bring the irrigated land up to 1,200,000 hectares, of which 400,000 hectares for cotton. The expansion of irrigated areas is indicated as due to large projects -- about 140,000 hectares; and small projects -- about 100,000 hectares.

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Besides the irrigation projects, there are also large drainage projects in the Trans-Caucasus SFSSR. The large areas of swampy lands in the Trans-Caucasus are located mainly in three sections;

- 1) along the Black Sea shores in the Kolkhida depression, where they exceed 120,000 hectares;
- 2) in the lower Kura river area, along the left bank above the junction with the Araks;
- 3) in the Erivan' trough.

Partial drainage of the Poti swamps has been started. Drainage works are being carried out to some extent in other sections as well.

VI

We have examined above the large land areas which require hydro-technical reclamation work in order to be used for agriculture. However, there are in the USSR enormous land areas, the exploitation of which is possible only as a result primarily of agro-technical methods (agro-forest reclamation work) and then partly, of hydro-technical measures. These are areas of sands and ravines frequent mainly in the zones of unsteady and insufficient moisture. According to the "Agroles" (agro-forest) data, following are the areas of these lands in the RSFSR:

	Sands	Ravines
Western oblast'.....	50,000 hectares	10,000 hectares
Moskovskaya and Ivanovskaya oblasts.....	15,000 "	22,000 "
Central Volga region.....	124,000 "	279,000 "
Lower Volga region.....	1,400,000 "	329,000 "
Central Black-earth oblast'....	54,000 "	220,000 "
North Caucasus.....	674,000 "	7,000 "
Dagestan republic.....	500,000 "	

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The sand areas of the Ukraine SSR cover about one million hectares, a particularly large section of which is in the Aleshki rayon. If reclaimed, it could be used for grape cultivation and other crops. The ravine area in the Ukraine is also very large. Works on the ravines during the present Five-Year plan extend over the following ravine systems: Ovruch-Sloveshchinskaya, Pridesninskaya, Priros'evaya, Taslinskaya, the Donbas ravines and others. Their reinforcement will add about 20,000 hectares to the agricultural area.

But especially large sand areas we have in Central Asia, where they reach several tens of millions of hectares. The problem of reclaiming and using these areas has not yet been studied at all.

At the conclusion of the present brief essay which shows clearly the incompleteness of our data on the presence in our Union of unused, "inconvenient" land areas in different areas, and on the possibilities of using adequate reclamation to bring them into the agricultural turnover, we consider it absolutely necessary to consider most seriously the question of a systematic and detailed registration and cadaster of all free land areas which need reclamation. Also, the possibilities of accomplishing such improvements should be studied. This question has been raised before, but it has not yet been adequately worked out. Now its solution has become absolutely necessary and if it is worked out, the author will consider the task of the present essay accomplished.

Supplement: Map of reclamation possible in the USSR, in connection with the problems of the plant-growing, compiled by A. N. Kostyakov.

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SCHEMATIC MAP OF THE PRINCIPAL RECLAMATION PROJECTS IN THE USSR

Legend: Green dots - projects for irrigation
Red dots - projects for drainage
Grey shaded - areas for development of
water supply.

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RESTRICTEDDIVISION OF FIELD CROPS INTO DISTRICTS IN THE USSR

N. V. Kovalev

The planned specialization of agriculture can be accomplished only under the conditions of the soviet regime and the socialistic economy. Under capitalism, where the national economy interests are treated by the governing classes as the interests of large-scale owners, where the profit determines the action.-- specialization in our sense is impossible. Private ownership contradicts and excludes a planned specialized economy in general and that of agriculture in particular.

The agricultural specialization, which is formed under the conditions of the capitalistic market economy, will be always distorted, incomplete, and never be rationally worked out. This is because the uncontrolled market and the cruel laws of crises and competition not only stop economic development and its rational specialization, but they constantly throw it far back from the level of achievements attained during one or another period. And under the conditions of the capitalistic regime's between-crises periods, the anarchy of production, the permanent fear of crises also competition, force agriculture to safeguard itself by way of numerous crops of great variety and not uniformly planned. Under the conditions of competition, not only a firm direction and a steady economic course in the perspective is impossible, but even a strong positive answer for tomorrow.

Inasmuch as the entire national economy under the capitalistic regime, based on the principle of private ownership of the production capital, can not be planned -- its separate part, agriculture, can not

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be planned either. Therefore, it is quite clear, that the truly planned rational specialization can be accomplished only under the conditions of the Soviet socialistic economy, meaning by that the specialization of the entire country, whole republics, regions and districts, as well as the specialization of single large Soviet and collective farms. Only under the Soviet regime, where the interests of a single farm, district or region are tied together with the plans of the entire national economy as a whole, are subordinated to the interests of the entire working people,-- is it possible not only today, but tomorrow as well to have definite direction in the development of one or another branch of the economy. Only under these conditions is it possible to establish concrete tasks to be assigned to one or another part of the economic system. The October revolution of the proletariat in alliance with the peasantry, secured all the prerequisites for the development of the socialistic economy and the planned economy.

With the strengthening of the Soviet Union's national economy, the planned economy is being carried out more completely, enveloping more widely and more deeply all branches of the national economy. Not so long ago, agriculture in Russia represented a semi-natural type of economy, where fifteen million separate peasant farms produced the most variegated products for the farm itself, and only in some areas, where they produced for the market, was specialization complete. However, this specialization under the conditions of the capitalistic regime was built on the foundation of self-directed market relations and this could not in any degree be considered a rational specialization, similar to that being carried out in the USSR. Only the Soviet Union, having destroyed private property over the means of production could

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accept the task of developing a rational specialization of economy. It is natural and comprehensible, that the planning principle in the national economy is getting stronger with the strengthening and development of the socialist construction.

The greatest achievements in the field of socialist industrial development, the building of industrial giants, made it possible for us to confront the problem of socialistic reconstruction in agriculture as well.

At the present time, our success in this domain -- collectivization of up to 60 percent of the peasant economy, construction of the largest sovkhozes in the various branches of agriculture, agriculture's mechanization, and an expansion of the power potential -- all this makes it possible to introduce the planning principle much more firmly, even to the problems of area specialization and the problems of rationally locating agricultural crops and varieties. Under the conditions of market relations of the capitalistic economy, specialized emphasis is unplanned or according to the terminology of the bourgeois economists -- the economy evolves. Then, under socialist planning, in contrast, specialization within the economy can be built and is being built on a rational basis. For purposes of rational economy specialization, we can not take as a foundation the data of the accidental elemental evolution created by market conditions. The market itself under the present USSR conditions is affected by the sphere of planning, inasmuch as the commanding heights of the national economy and trade are concentrated in the hands of State organizations, cooperatives and collective-farm associations.

Under the conditions of the Soviet Union, specialization of agriculture is an inseparable and obligatory part of the plan for the

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Socialist construction of the entire national economy. This plan undertakes the proper distribution of tasks and labor among the various branches of national economy and parts of the USSR.

If the bourgeois philosophers concerned themselves with the explanation of phenomena at all (and the bourgeois economists have explanations for the evolutions of the economy and the stages through which it has passed), we set ourselves the task of changing and reconstructing the national economy, arranging a reasonable social distribution of labor among the different parts of the USSR.

Rational specialization makes it possible for us to achieve maximum satisfaction of the working people's needs, to reach the highest labor productivity at the lowest production cost and at the same time to accelerate the country's industrialization, speed up collectivization and the tempo of socialistic development in general.

Specialization permits rational use of nature in the area, and makes it possible to obtain a maximum of mechanized labor and full use of machines.

Therefore, the XVI Party Congress put before agricultural science -- as one of the most important tasks -- the problem of studying the efficient exploitation of the different areas' peculiarities and the rational distribution of crops and varieties as well as the introduction of new crops to provide industry with raw material. This problem is extremely vast and responsible. It is, of course, necessary to consider, that the distribution of crops indicated for today is only the first approximate and, depending on further successes of our socialistic development, it will be changing, while in progress. [REDACTED].

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The basic distribution direction is given by Gosplan USSR in its directives for the Five-Year Plan (published in 1932):

"The distribution of the production potential in agriculture which constitutes the most important link in the national economic plan, has to be in complete conformity with the development of socialist industry and transportation and also with the formation and development of new industrial centers and areas. The agriculture of each area has to wholly satisfy the needs of the processing industry working on local agricultural raw material, and to secure completely the supplying of the workers and the city population of large industrial centers with agricultural products which are to be used fresh, and can not stand up under distant shipment (milk, vegetables, fruits, berries). In supplying these centers with other kinds of agricultural production, nearby agricultural areas must be relied upon. This is necessary so as to relieve the transportation system as much as possible of the burden of carrying shipments of farm produce. The already existing as well as the new enterprises of light industry and food industry, the largest meat-packing plants, synthetic rubber plants, sugar factories, etc., have to be provided with raw material base in the nearby agricultural area and the agriculture in these areas has to be directed towards projects which take into consideration the raw material needs of the processing industry.

In reorienting the raising of field crops, each region and district has to set itself a goal for obtaining maximum volume agricultural production, providing grain products for the needs of the local population and fodder for animal husbandry. In order to provide food and raw material for the needs of large industrial areas, for export and other national needs -- large centers of goods

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production (wheat, cotton, new fiber crops, meat, butter, wool, etc.), have to be organized during the second Five-Year Plan.

Of particular importance will be the development of new branches and crops, especially those which will free the USSR from foreign dependence (silk, tea, rubber-bearing plants, etc.). These crops have to grow considerably in order to cover the country's needs."

The distribution of crops is a part of the general problem of sectional specialization and is related to general economics of the national economy as a whole, and the area under consideration in particular. What can be done depends upon the distribution and strength of power stations, the local prospects for industrial development, the railroad and water transportation systems, means of communication, the degree of farm mechanization, etc. Specialization means that production assignments must be worked out for each area. It is quite understandable that these assignments can not be determined once and for all. These assignments are determined not only and not so much by the natural conditions, as by the combination of social-economical relations and technical achievements.

It is understandable that the growth and development of industry which turns the backward areas into forceful industrial and power centers (Kuzbas, Karaganda, etc.) and the social and technical reconstruction of agriculture, change not only the assignment volume for the given area, but the character of these assignments for the area or region, as well.

This establishes a sharp distinction between the specialization carried out by the Soviet Union and the "specialization " which was developed by bourgeois economists and wreckers (Chay'anov, Kondrat'iyev),

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who did not want to see the successes of socialist construction, and who opposed this development and credited the market and the natural conditions with the main role.

Work on agricultural specialization is carried out by a number of institutions and is unified by the Institute of Agricultural Economics and Reconstruction of the Agricultural Economy. The present work, the work of the Institute of Plant Cultivation considers the general requirements of national economy, without their numerical expression. This institute has to give a preliminary outline of a reasonable distribution of crops based upon natural limitations. In other words, it has to work out the potentialities for expanding production, to the extent that such production depends on natural conditions. Such division is artificial and would be harmful if it were not purely a work method, temporarily adapted with knowledge of its shortcomings.

The assignment of crop distribution is indeed colossal because it is necessary here -- taking into consideration the possible problems of national economy for the given region or district -- to consider also, almost to the letter, for each crop the adequate qualitative characteristics according to separate areas, that is, the intensity of yield of a given crop and variety, quantitative and qualitative content of various production substances (starches, sugar, proteins, fats, fiber yield, etc.) for different purposes, adequate merchandising properties of products -- characteristics of fruits: their transportability, durability in storage, suitability for dehydration, canning, etc. It is necessary to determine by means of the quantitative and qualitative indicators on hand the value of each crop and variety, the relation between the quality and

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quantity of production -- and the natural conditions, the field chemistry process, mechanization and prospective agrotechnical methods influencing the environment.

Based on the data of the mentioned general and particular accounting, it is necessary to determine those zones and areas of the Union in which one or another crop or variety can yield the highest production of best quality. If the crop distribution was based only on the natural data, without taking into consideration the general demands of the national economy and its economics as a whole -- then such division into sections in itself would have no practical sense, because the natural conditions and the division into sections done according to these conditions are providing only the general background, where important corrections should be introduced, which sometimes radically changes the situation. A great number of crops have the most favorable distribution conditions in the same sections of the USSR. For some crops, such areas are far more limited than for others and therefore, the crops which can not be grown or can not produce even somewhat satisfactory yields in other sections, should be placed in these areas ahead of other crops.

It follows that the general assumption must be changed, that crops must be grown in those areas best suited to them; and some crops must be taken from such favorable areas and be developed in other regions. For example, in Central Asia and in the Trans-Caucasus, very many crops can be cultivated and they find for themselves relatively good conditions. At the same time the national economy requires the distribution in these areas of such crops as cotton and southern subtropical crops. This requirement forces

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many crops from these areas, thus bringing about a basic correction to the regionalization on a purely natural basis.

But this is still not enough. As we already indicated, it is necessary to take into consideration both the present and future power generating centers and the prospects of industrial development in the areas. The Dneprostroy development allows to approach in a different way the problem of securing humidity for the southern USSR with the irrigation of up to one million hectares, which can not but influence the crop distribution. The Kuznetskiy basin development, with its power centers, can not but affect the crop distribution of this enormous area along a thousand kilometers. The social reconstruction of agriculture allows us to present in an entirely different way -- more clearly and firmly -- many problems of sectional specialization. And finally, it is necessary to consider that the successes of industrial technique and farm mechanization, are introducing essential changes in the sectional division of crops and permit specialization at a faster rate. It is understandable that the specialization of areas and farms in them, raising the general productivity of labor on the basis of rational utilization of local natural resources and conditions, requires a highly developed transportation system and an adequately organized mutual supply of products among the specialized areas for their uninterrupted work.

While the general contours of sectional specialization appear clearly enough against the background of the tasks of the national economy, the detailed solving of problems of crop and crop variety distribution becomes complicated due to the fact that:

- (1) A number of the Soviet Union areas, and especially areas of our border lands, we do not know well enough;
- (2) At the present time we do not have data on the number of crops and particularly, the number of varieties, in a number of areas.

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Nor do we have data on the dependence of quantitative and qualitative properties of a crop upon the area's natural conditions or agricultural methods, and finally,

(3) Regionalization of crop location is decided on the go, during a stormy growth of industry and socialist construction in agriculture. And in this dynamic movement of things, the tasks of each individual area lag behind, and in connection with this, the location of crops does not receive due attention, and continually will require correction.

Thus our contemplated crop locations are, so far, only preliminary outlines, which should in no measure be considered final. Nevertheless, planning crop locations can not be further postponed, because the need for this is present and the time is ripe, particularly in connection with the new Five-Year Plan. This is proved even by the fact, that actually, a considerable part of the data and conclusions given in this work have already been carried out in practice by way of distributing crops during the 1931 fall sowing campaign, by planning the 1932 spring sowing campaign, and in the development of sovkhoses and seed industries, etc. The leaders of the different sectors of the USSR People's Commissariat of Agriculture (Narkomzem), of economic, state and collective-farm systems, in the process of carrying out our work together with us, have derived from this work the necessary practical conclusions which came from doing the actual work.

The great task of creating a map of efficient distribution of agricultural crops can be carried out ^{not} only by the entire collective (group) of scientific workers from the Institutes of the All-Union Academy of Agricultural Sciences imeni Lenin but also by the entire

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collective of production workers, office workers and workers of individual enterprises. In this connection, everyone must do his share of this work.

We have to stress once more that according to the instructions of the Academy Presidium, working out the scheme of regionalization is the responsibility of the Scientific-Research Institute of the Organization for Socialistic Agriculture and Economics (NIOKSKhE). The Institute of Plant Cultivation is responsible, as mentioned above, for working out the tentative part of the crop location plan. This involves a reasonable distribution of crops by nature zones, but taking into consideration the needs of the national economy as a whole as well as the over all prospects of one or another area.

An analysis of all the conditions of nature indicated below, is necessary in terms both of the over all picture and of the particular crop. This analysis covers the varieties of crops, relative to their interaction with environment, and also it measures the influence of agricultural techniques, the yield, the reliability of crops and varieties, quality of production, etc. Such an analysis is needed both for the present time as well as for the future, in order to determine those tasks which in terms of the reconstruction of agriculture mean the introduction of new crops and varieties.

The need for regional location of crops is of particular importance at present. This is because now that field cultivation is done on a basis of planning, and now that collectivization has met with rapid success following the turning point in 1929, this has made it possible to widen considerably the sowing area of the Union and improve the prospects for bringing new lands into use and

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more intensive farming of field crops. This is envisaged for the immediately following years as is seen below from Table No. 1.

We see a slow process of sowing area expansion during the first years after the war and the revolution, and then a rapid speed up beginning in 1929. This made it possible in that year to exceed considerably the prewar figures. The total figures of the Union's sowing area increased from 114,528,000 hectares in 1928 to 119,589,000 hectares in 1929, reaching 127,767,000 hectares in 1930 and 137,515,000 hectares in 1931, which represents an increase of 17 percent against the prewar figures for the present territory of the Soviet Union.

Among single republics and regions, the first places in sowing areas of 1930 belong (after the RSFSR) to the Ukrainian SSR and within the RSFSR -- the North Caucasus region, the Central Black-earth region, the Central Volga region and the Siberia region.

The greatest increase of sowing areas in 1931, as against 1927 gave:

Lower Volga - - - - -	52 percent
Central Volga - - - - -	45 percent
Kazakstan - - - - -	41 percent
Bashkiriya - - - - -	39 percent
Urals Region - - - - -	30 percent

Such expansion speed of sowing areas and of their regions compels us to pay special attention further on to the prospective relative importance of further intensive and extensive farming of field crops, with emphasis in one direction or another. (The relative significance of sowing areas in the Union for various crops in 1931 is seen from the table in the supplement to this section).

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The present work intends to compare the natural requirements of various different crops and in this connection, to consider the significance of the individual areas, compiling for each of them an outline of leading and complimentary crops, limiting this work to field crops. Special separate studies are devoted to regionalization of vegetable and fruit-berry plants.

Even though the work submitted represents a first outline of regionalization predominantly on the basis of natural factors, and in this respect constitutes only the data for the final development by the economists of the Soviet Union's plan for field crop cultivation yet it is evident that the authors of this work, starting with general reconstruction problems, have tried to a maximum degree to consider also the economy factors indicated in the instructions of the USSR Gosplan and other government agencies.

The plan on crop distribution being described is worked out on the basis of: data of oblast, kray, and republic planning agencies, economic organizations and scientific institutes, writings on individual field plants done for the present publication by a number of specialists of the VIR All-Union Institute for Plant Cultivation, practical material of the results of comparing crops and varieties of the State system for testing varieties and by experimental institutions, various literary sources indicated at the end and, finally, exchange of opinions in a number of conferences on that subject by a special VIR commission. In this connection, there were various points of departure. These considerations included supplying industrial centers with sources of raw material, and with food products, export requirements and needs for the domestic market, and then, consideration of the possible expansion of adequate crops, depending

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on favorable factors or factors limiting the importance of the given crop. Other considerations include the soil climatic factors of individual areas, relative yield and stability of crops on the basis of statistics and data of experiment sections of the variety testing systems; comparative production quality in relation to the influence of climate and soil of different areas, and the necessity resulting from this to consider the increase in sowing of one or another crop in the respective areas in order to be able to better evaluate the material for export or for technical use. Besides that, in clarifying the relative value of crops being compared in various areas, consideration was given to the present crop distribution, and particularly to the large-scale experiments in moving some of the crops during recent years and the possibilities of reclamation and use of lands (according to the data of special articles in the present publication).

In the thus obtained work, there is the crop distribution according to republics, regions, districts and also natural areas and zones embracing parts of separate regions and districts. Absent from the work is the crop distribution in one or another type of farm, because the farm types themselves are not outlined yet by the Collective Farm and Sovkhoz Institutes. As crop location is not given by types of economic specialization, at first glance, the variety of crops in some of the territories and districts seems very large. For example, there is a whole list of root tubers (rape, turnip, sugar beet, chicory) which often is given for the same regions. In developing different types of farms, the choice of each area's crops -- seemingly manifold -- has to be redistributed and properly adjusted to the emphasis of each farm. It is quite natural that for the type stressing mainly grain growing, there will be a minimum of

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row crops and technical crops. On the other hand, for farms which stress technical crops (cotton, flax, etc.), the grain crops will be kept to an established minimum

In the first volume of Plant Cultivation in the USSR there are special sections devoted to the location of such crops as are important to the national economy as grain, food and feed plants and fodder grasses. For the problems of cultivating technical, vegetable, fruit and berry crops there are special studies and such crop location problems will be given in the proper sections of the second volume of Plant Cultivation in the USSR.

The length of the articles by individual republics, in no way indicates the importance of these republics in the national economy or the attention paid to them by the Institute and the authors of this work. For example, it was taken into consideration, that the Ukrainian People's Commissariat of Agriculture (NKZ) publishes detailed data on regionalization and therefore, in this work the data is given in a more concentrated form. On the other hand, the limited presentation on such parts of the USSR as Siberia, or Kazak^hstan, is due to the insufficiency of data available to the authors, and an inadequacy of such data also on the spot. Basically, we considered it necessary to throw more light upon those parts of the USSR which up to now have been written about less completely.

The authors are aware of all the defects of the present work, particularly those due to the hurry in which it was done and to the fact that it was already too late to include the following remarks and corrections.

The present summarization edited by N. V. Kovalev and V. V. Talanov, is compiled within the boundaries of the northern

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non-black-earth part of the Union, while Eastern Siberia and the Far East -- by V. P. Kuz'min; on the forest-steppes, steppes and other southern zones of the RSFSR and the Ukrainian SSR -- by V. V. Talanov; Trans-Caucasian Republics -- by P. M. Zhukovskiy; on Central-Asian Republics the work is carried out by a commission consisting of E. V. Bunakov, M. G. Popov, N. N. Sapozhnikov and R. T. Abolin; the latter also prepared the last part.

P. M. Zhukovskiy was closely connected with the work on technical crops and P. P. Ivorykin -- on fodder. The meteorological data is from published sources as well as on the basis of practical material gathered by the Agrometeorology Division of the VIR.

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REQUIREMENTS OF INDIVIDUAL CROPS UPON VEGETATION CONDITIONS
AND POSSIBILITIES OF MOVING THEM FORWARD AND FROM ONE REGION
OF THE USSR TO ANOTHER

V. V. Talanov and V. P. Kuz'min

GRAIN CEREALS

Spring Wheat

Our basic food crop -- spring wheat -- makes certain demands upon soil-climatic conditions, in order to obtain sufficient yields, resistance and good grain qualities. Its high yield is connected with sufficient precipitation in May-July and especially with soil and air humidity during the period the spike is forming, and the grain is blossoming and ripening.

Even when precipitation is more or less sufficient, the low relative air humidity during blossoming, connected with high temperature and strong drying winds, can become a factor greatly lowering the yield of spring wheat, making it impossible to move this grain crop into certain areas. Other reasons limiting the possibility of expanding and moving the spring wheat area are: the required minimum growing period (which makes it difficult to cultivate high yield types of wheat in the north, due to the short duration of non-frost periods); the harm done by pests, particularly by the Swedish and Hessen flies, which do not allow yet a sufficient development of spring crop wheat sowings in the northern part of the Central Black-Earth Oblast, in the south of the Moscow and Ivanovo Oblasts, in a considerable part of the right-bank Nizhniy-Novgorod Kray and the Central Volga area, as well as the extreme northwest part of the Lower Volga region; and, finally, harm done by

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various fungus diseases, which are especially prevalent in more humid climates and which can be reduced only by introducing resistant crop varieties (Far East and the more humid part of the North Caucasus).

Regarding the question of areas, where it is desirable to intensify and move the spring wheat crop, we must pause over three relevant points. First, is a consideration of the borderline of possible expansion and movement of spring wheat to the east and north. Then, there is the question of insuring yield by sowing winter wheat in areas most suited to it. Finally, there is the matter of the relative value and yield capacity of tough and soft spring wheat varieties.

We assume, that the necessary expansion of the more valuable crops in the more favorable, for them, warm and sufficiently humid sections of the North Caucasus and the Ukraine, will require not only limited sowing of barley there in favor of corn, but also moving part of the spring wheat crop from these sections into other areas.

At our disposal we have averages for 20 prewar years on yields of spring wheat on peasant lands, which, of course, under the new conditions of large scale mechanized socialistic economy, have no real meaning in themselves, but so far, they are the only data for the comparison of yield in different sections over many years. At the same time, averages indicate dependence upon precipitation during May-July.

We can see from this data, that the highest mean yield of spring wheat on peasant lands before the war was in the Kuban' River area; 7-8 centners (with a mean precipitation, May-July, above 150 millimeters.

At the same time, at the opposite end of the spring wheat area -- in the northern forest-steppes of West Siberia and Trans-Urals

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(also well humidified, with a mean precipitation, during these months, above 150 millimeters) similar mean yields were obtained--- above 7 centners per hectare, reaching in the foothills rayons of the Biyskiy and Kuznetskiy Okrugs, even up to 8-9 centners a hectare.

Slightly lower, but also similar yields of 6-7 centners a hectare and comparatively steady ones, were obtained in the northern steppes of the Ukraine, in the Donetsk basin, in the Donskoy and adjoining parts of the former Sal'skiy and Stavropol'skiy Okrugs. But at the same time, a comparable yield was obtained in the southern forest-steppes of the Trans-Urals and Western Siberia (in the former Kurganskiy, Omskiy, Chelyabinskiy, Kamenskiy, Barnaul'skiy Okrugs) as well as in the Petropavlovsko-Kokchetavskiy Rayon of Kazak^hstan and the Altay foothills -- with 130-150 millimeter precipitation during May-July and with comparatively few arid, poor crop years.

The Ukraine's eastern steppes, the arid steppes of the North Caucasus, the forest-steppes on the Central Volga's left bank and also the farther south arid southern black-earth parts of Trans-Ural, Western Siberia and Kazak^hstan -- have a considerably lower and very unsteady yield (5-6 centners per hectare), which is due to the low precipitation (mean 130 millimeters during May-July) and its falling down to the minimum quite often in some years.

In the arid steppes of the Central and Lower Volga, especially in the Lower Trans-Volga, where the mean precipitation during May-July is 75-100 millimeters -- the average yield capacity drops down to 4-5 centners. The same is observed in the former Temirskiy, Akmolinskiy, Pavlodarskiy, Atbasarskiy Okrugs of Kazak^hstan, with very frequent extremely arid years causing exceedingly poor crops (3-4 times during the 20 prewar years). Besides, there are in the latter mentioned

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regions many saliferous as well as detritus soils, little suited to agriculture; with frequent tremendous droughts it is not expedient to move the wheat into these regions (at least not in the near future) until specially drought-resisting wheat varieties are introduced and until farming techniques make great strides in the fight against drought.

The resulting general conclusions in connection with wheat's movement to the east, come down to the following:

The gradual decrease of spring sowings in the North Caucasus and the Ukraine is quite possible parallel to the increase and intensification of its cultivation in the forest-steppes and black-earth steppes of West Siberia and Trans-Urals, where, as we have seen, the mean yields are not lower than those of the Ukraine and North Caucasus. There it is quite possible to expand wheat areas since there are free wastelands and wheat crop rotations can be intensified.

To a lesser degree, spring crop expansion is still possible in the black-earth steppe and in the northern part of the dark chestnut-brown steppes in the Trans-Urals, West Siberia and in Kazakhstan, but with considerably lower yield and great risk of poor crop years. As to the region located south from the Orsk, Semiozernaya, Atbasar, Akmolinsk, Pavlodar, Semipalatinsk line (where the precipitation is less than 300 millimeters a year, and less than 100 in May-July) and a considerable part of the Pavlodarskiy Okrug, which has saliferous lands in the northwest, the expediency of a more or less considerable movement here of spring wheat in the near future is very doubtful. In any case, it is possible only after a thorough preliminary exploration of these Kazakhstan territories: their climatic conditions, whether there are non-saliferous, non-detritus lands, the possibility of obtaining

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fresh waters, the possibilities of extreme decrease in wheat cultivation expenses through an extensive use of mechanization, which would make intense wheat cultivation worth while even with an average production of 4-5 centners a hectare. Finally, the probability of periodical absolutely poor crops should be taken into consideration, as well as the necessity of the later following conversion to fallows with corresponding expenses of fallow cultivation.

As to the arid Trans-Volga, considerable perspectives for area expansion and increase in wheat production will open up after the completion of the great irrigation projects ("Greater Volga", etc.), which could give not only vast fodder crop areas for animal husbandry in the southeast, but also (together with some technical plants) of wheat farming development on irrigated lands.

The spring crop wheat production increase within the boundaries of the forest-steppes and less arid parts of the Trans-Urals, West Siberia and Kazakstan steppes, can be large enough if there is adequate crop rotation with grasses and partly with fallows, which would insure the maintenance of more stable yields. This trend will make it possible to remove much of the spring wheat crop from the Ukraine and the North Caucasus. At the same time, as additional guarantee of spring wheat production in case of drought an adequately large area would be kept under winter wheat in the "sufficiently humid" zones of North Caucasus and the Ukraine.

The movement of wheat to the central part of our Union (southern part of the Moscow and Ivanovo Oblasts, the right bank of the Nizhniy-Novgorod Kray and the Central Volga and the northern part of the Central Black-Earth Oblast) can be permitted only if the selection stations effectively solve the problem of introducing varieties which will resist the Swedish fly and other unfavorable conditions of the area.

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As to the non-black-earth north, even though in this part of the Union, wheat has been assigned a relatively unimportant place, due to the expansion there of fodder crops, flax, potato and grey cereal grains, at the present time, nevertheless, wheat must receive adequate emphasis here, particularly in connection with a growing emphasis on clover sowing and the expansion of vetch grown in rows -- an excellent preparation for spring wheat.

Within the boundaries of the non-black-earth belt of North Siberia and the Far East of the USSR, spring wheat has the possibility of a very great expansion in the Southeastern Trans-Yenisey area, where the summer conditions permit a wide expansion of early spring wheat varieties. These conditions include strong sun radiation and moderate precipitation, on more fertile, weakly lixiviated, podzolic soils, which frequently are rich in humus and turning into black soils.

To the east, beginning with the Yenisey, in the open taiga and forest-steppes part of the area, in some places steppes, in a wide belt taking in the Predbaykal'ye, Buryatskaya SSR, southern part of the Yakutiya, Zabaykal'ye (Trans-Baykal) and Priamur'ye, spring wheat can be in most cases in the group of basic grain crops. Only in the Primor'ye in the future it may lose in importance to soy bean, and rice, corn and the millet family crops taken together. The too short growing period and the not infrequent effects of early fall frosts are very noticeable as they are on other grain crops. Besides that, in the Far East exceptionally abundant summer precipitation and fungus diseases are very harmful. In connection with it, in spite of generally high wheat yields, the quality of the grain is, on the whole, not good, either for marketing or for food.

As to the northern part of the European area, spring wheat can be intermittent or located on "island" areas, due mainly to the

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particularities of soil conditions and also to the location of agricultural pests. Soil types according to their mechanical and chemical characteristics, their structure, the ground water level, etc., are here the deciding obstacles requiring a basic change through reclamation and the application of agrotechnical developments. Spring wheat fields here are more reliable in the zone of southern coniferous and mixed forests, than in the deciduous zone, where fungus diseases, Swedish fly and a number of other yet little known causes are limiting the prospects for this crop. Within the boundaries of the swampy coniferous forest zone, wheat crops are adapted mainly to dry terraces of river valleys, the warmer loamy and sandy loam, usually carbonate soils. Under these conditions and using early varieties, wheat can move as far north as field cultivation crops are grown.

Depending upon the condition under which mildew-resisting early varieties are introduced, and depending upon soil conditions (the same "wheat" soils) spring wheat can succeed also in the humid western part of the forest covered north.

As one of the decisive factors for spring wheat expansion in the northern part of the European area, should be considered the cost of bringing in wheat grain since wheat always has here a claim to better soils, which could be used very successfully for more valuable crops: flax, beer-brewing barley, etc. But in terms of planning the wheat area can be increased here considerably at the expense of other crops, mainly following tilled crops and clover. Taking into consideration the existence of early-ripening spring wheat varieties, their response to calciferous fertile soils, lack of weeds, etc., it is possible at the present time to influence quite strongly the geography of spring wheat plantings. The development of grass-field rotation,

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which effects soil structure, the tremendous extension of fallow plowing, which frees the soil from weeds, extensive use of mineral fertilizers and lime, and, in regard to the plant itself -- the use of early high-quality spring wheat varieties and in the future of "vernalization", etc., together with the study of cultivation techniques for spring wheat under the conditions of northern agriculture -- this is what provides an entirely different background with different aims for the solution of the wheat problem in the northern forest belt. Besides the sub-taiga and the southern taiga of the entire Trans-Urals in the northern part of the Soviet Union, where spring wheat can be widely cultivated, such crops can be developed considerably also: in the Central and Southern Predural'ye, in the southern part of the northern kray and almost in the entire Nizhniy-Novgorod Kray in the European part of the Union. Besides this area, which is more continental and more suited to spring crop wheat in regard to climate and soils, its crops can be greatly increased in the profusely humid belt: in the north of the Belorussian SSR, the Western, Moscow and Ivanovo Oblasts, as well as in the central and southern parts of the Leningrad Oblast, especially since the development here of reclamation projects and the use of mildew resisting varieties.

Scientific research clarification of the reasons for spring wheat failure in the broad-leaf forest and steppe-forest belt of the European area, will certainly make it possible in the nearest future to join together the wheat zone of the steppe-covered south with the wheat "islands" of the swampy-forest north on the fertile but non-wheat black-earths of the northern forest-steppes. For grain farming in the north this problem is of great importance, in connection with the fact, that the grain areas of the northern republics, krays and oblasts -- with the specialization of field industry -- belong in the majority of

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cases to the broad-leaf forest and the northern forest-steppe belt, where they have at the present time to be based mainly on rye and oats crops.

As to the southward movement of spring crop wheat, within the boundaries of the southern Ukrainian and Crimean steppes and the arid Prikum'ye steppes (in North Caucasus), it is not expedient, because spring wheat yields here are very low, due to dry winds during the blossoming and ripening period. Its yields are considerably lower than those of winter wheat which moreover, is a grain of first class quality.

In working out the rayons for specialization in spring wheat, it is very essential to clarify where it is necessary to give preference to hard wheat versus soft wheat. On the basis of data compiled by the variety-control system and the experimental institutions it was made clear, that the hard wheat varieties on old arable (but not too weedy) soft lands can give not only a high yield, but even a higher one than the soft wheat, in such regions as: southern forest-steppes (former Khar'kovskiy Okrug), semi-arid southeast steppes of the Ukraine (former Dnepropetrovskiy, Artemovskiy, Stalinskiy, Mariupol'skiy, ~~Donetskiy~~, Luganskiy Okrugs), as well as in the Donetsk, Donskoy, Sal'skiy Okrugs of the North Caucasus. Of course, the cultivation of hard wheat varieties can not be limited to this one area. They also have to be cultivated in the enormous areas of waste and virgin lands on the grain sovkhozes and kollekhoses of Central and Lower Volga, Trans-Urals, West Siberia and Kazakstan. There, however, the more the land is cultivated, the more the soft wheat will be ahead with higher yields, with the result that hard wheat could be preferred only because of less loss through falling off and frequently a higher price for export.

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As far as winter wheat is concerned, we consider that the regions most suitable for it are those which have mild winters and sufficient precipitation. Winter wheat can stand low summer precipitation much easier than the spring crops. Of particular importance for it are of course the conditions which insure it against destruction by frost. In this respect, the safest regions should be considered those with January mean temperatures not below minus 6 degrees Centigrade. This includes the former Kubanskiy, Maykopskiy, Armavirskiy Okrugs and the corresponding parts of the "zone of sufficient humidity" in the Adygeyskaya Autonomous Oblast and the foothill parts of the former Terskiy, Stavropol'skiy Okrugs and the autonomous oblasts of North Caucasus. Analogous conditions are in the forest-steppes of the Dnepr's right bank in the Ukraine.

This is our emergency wheat, though the quality of grain here is not very high.

The best areas for quality winter wheat are: the Crimean steppe, the southern steppe part of the Ukraine; in a lesser degree -- the eastern steppes of the former Terskiy and Stavropol'skiy Okrugs, on chestnut-brown soils which give a winter wheat grain of the best export quality, though with lesser crop reliability (due to droughts).

The next sufficiently (though somewhat less) favorable area for winter wheat is the western part of the Dnepr's left bank forest-steppes and also the so-called northern steppes (Moldavian ASSR, the former Pervomayskiy, Zinov'yevskiy Okrugs). Less secure from the point of view of destruction by frost, but able to give good yields during favorable years are the areas of the eastern part of the Dnepropetrovskiy, Zaporozhskiy Okrugs, the region of the Donetskii basin and the adjoining Donetskii and Donskoy Okrugs of North Caucasus, which have a much lower

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winter temperature (from minus 6 degrees to minus 9 degrees, January mean temperature). Due to the considerable lack of snow, a mass expansion of winter wheat plantings in these areas is inexpedient unless all the precautionary measures are taken against freezing.

This will probably be possible already in the coming years through moving winter resistant winter wheat "gostianum 237" into this region and by taking the necessary steps to use better agrotechnical methods; among which an important role can be played by earlier sowings of winter crops, establishing conditions favorable for snow retention, etc.

When all these steps are taken, winter wheat cultivation here can become sufficiently safe and therefore it can permit (provided its yields continually increase) a gradual decrease of spring wheat in this zone where it and rye had been predominant.

Special attention should be paid over the coming years to the forward movement of the winter wheat into almost all the regions of the Central Black-Earth Oblast. The existence at the present time of enough winter-resistant varieties, makes this movement quite possible, with the exception of only part of the oblast east of the Don, where this expansion is also possible, but only with great caution, with timely sowing of only particularly winter-resistant varieties of Saratov selection and with the practice of snow retention.

In the Central Volga and Lower Volga Krays, along the Volga's right bank, the expansion of the winter wheat cultivation is possible only with the most cold resisting varieties of Saratov and Bezenchuk selection, making use of snow retention. In the steppe part of the Volga's left bank, winter wheat cultivation to date is risky even with the most winter resisting varieties and with the use of all the best agrotechnical methods to prevent destruction by frost. Its future

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depends upon the prospects in the work of the Grain Farming Institute in Saratov which is developing rye-wheat hybrids and especially winter-resistant varieties of winter wheat.

Of great interest is the question whether it is possible to move winter wheat north, into the podzolic soil zone, in order to substitute it, where possible, for winter rye. Experimental as well as experience data tell us that in certain northern spots winter wheat can be a more profitable crop than winter rye, not only because of a higher value of grain, but also due to higher yields.

Winter wheat being so far only a little used crop here, it has not been sufficiently studied as to its requirements under new conditions, but the data which is already obtained indicates that the main limiting minimums for winter wheat in the north will be (aside from the question of warmth and snow during the winter season) soil fertility, soil structure, ground water level and soil acidity. Provided that the climatic conditions are the same, the main deciding factor will be the soils, which can be regulated through fertilization, introduction of crop rotation with grass-sowing, reasonable cultivation, lime treatment and drainage.

Preliminary experimental data indicates definitely, that through an adequate choice of time and methods of sowing, winter wheat, it is possible to fight quite effectively against climatic drawbacks and to influence considerably the success of wintering.

Experimental data and the results of actual sowings indicate that in relation to its requirements winter wheat has to start conquering the north at the western part of the forest zone: Belorussian SSR, Western Oblast, central and southern parts of the Leningrad, Moscow and Ivanovo Oblasts, with their milder winter conditions, and also the central and southern Predural'ye (Ural's foothills), with its deep snow. Within the boundaries of this climatically most favorable northern

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area, the winter crop wheat, however, could not expand without interruption.

First of all, clayey, structural soils with sufficient amounts of humus (carbonate, forest loam) should be chosen, while swampy, peat, sand, little developed soils, in low locations, etc., should be avoided.

Very much depends here upon the success of development and the acceptance in practice of rational agrotechnical methods. The introduction of winter-resistant winter wheat varieties of the specific bio-type (which can stand not only low winter temperatures when there is a sufficiently deep snow cover, but also the sweating out, the soaking), as well as the improvement of the cultivation technique must change immediately the scale of winter crop wheat plantings in the north and change the largely automatic practices from the path of evolution to the road of revolution.

The new large scale of reclamation projects and the general background of cultivated field crops -- which comes with socialistic reconstruction of agriculture -- will doubtless move winter wheat very extensively from the existing quite limited regions safeguarded by nature. The deepening of the selective work on this crop in the north of course will soon lead this crop beyond the above-mentioned basic northern border of the winter wheat zone.

Rye

This crop together with wheat is a basic food, mainly for the rural population. In the areas of less success with other grain crops, it has tremendous value as fodder but its importance as an export item is very slight.

Therefore the amount of rye production and its regional distribution to a high degree is connected with the production possibilities of,

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mainly, wheat and fodder grains. It depends upon the volume of grain needed and the amount of concentrated fodder available, as well as upon the question of competition between these principal grains when it comes to the distribution of crops.

Being a great cosmopolitan rye has the possibility of expansion all over the Union, but wheat's successful competition in the south is pushing rye northward, leaving it in the south only to a small extent to insure that there be grain crops there, where spring wheat is not very reliable due to the arid climate, while winter wheat does not succeed due to severe winter conditions.

Besides this factor (competition of a more valuable cereal), other important conditions have to be considered in assigning areas to rye.

As a crop, in terms of grain quality, it stands above those grains which follow it, in this regard: barley and oats. Rye, in spite of its sometimes low yields, has to move into regions once in a while not satisfying its requirements of natural conditions in the north. It is particularly important for those regions of the northern swampy-forest belt, which due to the extreme lack of roads are remote from grain supplies and from the main lines of transportation.

The demand for major relief for the transportation system in the near future from carrying supplies, by producing them locally, applies particularly to the northern areas of the Union, where the largest industrial centers of the country are located, with their large population which needs grain to be shipped in.

This raises the problem of the possibility of increasing the production of grain in the north without interfering with its own specific agriculture. By raising the balance in its favor, the non-black-earth north will, by transforming itself into a "productive" region, become less dependent in regard to grain.

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The necessity of saving valuable exports of southern grain, from consumption in the rest of the country, is a matter of immediate concern. It is possible to attain this in large measure by producing rye in the non-wheat-growing, non-black-earth north.

Analogous to the need of the population to supply itself with grain, is also the need to use rye for fodder in the northern animal-husbandry regions, especially in the far away areas not connected with the corn growing regions, and in the regions little suited to growing barley (forest-steppes).

All this makes it essential to move rye sowings northward, where it will find for itself in the majority of cases, favorable conditions for its growth.

Only the more populated northern industrial regions are limiting their needs for this crop as an economy factor; partly due to the fact that they are better served with transportation, and partly because they utilize their areas more intensely for specifically suburban varieties of crops.

The second limiting circumstance -- the necessity of having fallows -- is eliminated by the extensive introduction of weed fallows, which are quite necessary in the north specializing in dairy animal husbandry. At the same time, being a winter crop and demanding a more even labor distribution over time, as well as a more complete use of inventory, rye is particularly of interest for the north with its short summer and, therefore, great emphasis on work in the fields.

Besides its use for grain, winter rye is of great value as a very nourishing green fodder; with special fall sowings for spring feeding, and, again, particularly suited to the north and northeast of the Union where winter is exceptionally long and the grass grows in the spring as the snow melts away.

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According to its biological properties, rye is a crop much better suited to the climatic conditions of the north. With few exceptions, its highest and most steady yields are obtained just here.

As a crop developed from weeds, rye does not demand much in terms of soil conditions. Rye is second after oats among the grain crops to lay well-grounded claims to the low-valued lands like: peat swamps, sand soils, uncultivated forest clearings or soils cultivated by the seminomadic national minorities of the east.

Early ripening and the year long development cycle are tremendous advantages for winter rye in comparison with other grains. This insulates rye from the effects of summer droughts, from the damage caused by the fly family insects, from the unfavorable conditions of late fall harvesting. This makes it possible to make use of the abundant fall and winter precipitation and thus protect this grain from the lack of precipitation in the summer.

Being drought resistant and not demanding of the soil or its cultivation -- these are the main characteristics of rye -- particularly noticeable in its spring crop variety, which therefore is especially suitable and effective among the not agriculturally inclined population of Trans-Baykal and Central Asia.

As to the damage caused by fungus diseases and insects first of all mention must be made of the spread in the south of winter owllet (*Feltia segetum* Shif.). It is an extensive zone stretching from the Dnepr to the Volga, along the north of the Ukraine SSR, the southern Central Black-Earth Oblast and the north of the Lower Volga Kray, where it has two generations. Considerable also is the damage caused by this pest in the northernmost part of Nizhniy-Novgorod Kray and the southern part of the Northern Kray. There is also not a little fighting ahead against slugs in the humid warm west.

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The fungus diseases of rye are particularly manifest under the conditions of the extremely humid and warm summer in the Primor'ye, where the frequent result is "drunken" grain; this does not result with grain crops of the local Far-East varieties. Winter rye, winter resistant in comparison with other crops, has nevertheless its basic biological minimum in the combination of factors making it possible to survive the winter. The principal factors are thermic winter conditions and the function of the snow and ice cover. As a second biological minimum in dry regions, consideration should be given to the necessary amount of timely fall precipitation.

The analysis of soil-climatic and other natural factors in connection with the principal requirements of rye, make it possible to divide the territory of the Union and to outline a certain number of regions favorable for obtaining high and steady yields.

However, the distribution of rye planting areas in exactly this order would in many cases be radically contrary to the overall interests of the national economy. Here has to be indicated first of all the inexpediency of rye planting, in spite of its high yield, in regions where it is possible to cultivate a number of valuable technical crops and wheat.

The North Caucasus, Western Ukraine and the southern part of the Central Black-earth Oblast are the first examples of areas with the highest and most reliable yields of rye. Similarly, the entire spring crop wheat area of forest-steppes, which comes next to the northern forest region in rye yields, is not a place for rye, with the exception of those areas intensely plagued by the Swedish fly. To the contrary, in spite of hardly favorable conditions of drought and severe winters in the steppes of the North Caucasus, Ukraine, Povolzh'ye and Siberia, rye has to be continued there, though on a small scale, because of the even lesser stability of other crops,

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in order to be sure of yields in unfavorable years of drought or bad winter.

Rye does not meet with any obstacles in its expansion, connected with natural environment, in the entire forest zone, as well as in those parts of the forest-steppe where the spreading of the Swedish fly and other reasons limit drastically the possibility of spring wheat cultivation. Conditions for wintering or soil conditions as yet present considerable limitations to otherwise continuous areas of winter wheat in the Central Black-Earth Oblast, in the right bank area of the Central Volga Kray and in the belt of changing soils in the northwestern part of the Ukraine, in Nizhniy-Novgorod Kray, in the Tatarskaya SSR, in the Bashkirskaya SSR and in the Urals Oblast.

Within the area of the non-black-earth north, winter or spring rye has to be one of the basic grain crops almost throughout. There are limitations only in the densely populated industrial areas and at the northern limits to where field cultivation is possible, where the extremely severe natural conditions limit the possibility of sowing this grain, allowing only the cultivation of the most early ripening kinds of barley. The zone of southern coniferous and mixed forests in the non-black-earth north guarantees a yield of rye second only to that of the North Caucasus and Western Ukraine. In some localities of the non-black-earth north, where insufficient precipitation and soil humidity limit the sowing of oats, the prevalence of the Swedish fly limits barley, or the exceptionally low natural soil fertility requires frequent fertilization and it rules out a number of intermediate crops -- rye remains the only basic grain crop (such are, for example, the sand stretches in the south of the Nizhniy-Novgorod Kray, in the Ivanovo, Moscow, Western Oblasts and

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the Belorussian SSR, and in the Poles'ye of the Ukrainian SSR). Those are the basic economic and natural factors determining the distribution of this country's second primordial crop in the reconstruction prospects for field crop varieties of socialist agriculture.

Oats

The principal factor determining oats production in the future is the substitution of machines for its main grain consumer -- the horse. Correspondingly, the amount of oats grain production will be changing depending upon the increasing demand for tractive power, and, on the other hand, on the rate of mechanization in agriculture, transportation and in those industrial enterprises (forest, mining) where the horse was of great importance. In view of the tremendous general importance today of the horse, with the need to improve its feed, there is hardly need during the next years to decrease the oats grain production. The regionalization of oats sowings, as far as possible, should correspond to the depopulation of horses.

Oats consumption in food is not large. Neither is it of any great importance for export. However, to meet export requirements, grain must be produced in regions where it will yield its highest merchandising qualities.

A factor of extreme importance in determining the extent of oats production and its geography, is the possibility of replacing it with fast growing corn withdrawing grain in the south and southeast and combining its plantings with other more valuable crops.

According to their biological properties, oats are exceptionally non-exacting as to growth conditions. The principal advantage of this crop derived from weeds, consists of its ability to get along with the left-over fertility, following the growth of more valuable crops. Together with rye, oats represent one of the most reliable swamp crops.

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Oats gets along well with all the various poor podzolic soils. Oats is very little affected by insect pests. The most important fungus disease of oats -- smut -- injures it more severely in the more arid regions.

The possibility of gathering by the means of this crop a great amount of foodstuff from the least valuable areas and under less favorable conditions, brings up the necessity of research in the field of a more complete and heterogenous utilization of oats, analogous to what is done in the south with soybean, corn, etc.

The principal demands of oats upon the environment are climatic, and first of all: great amount of humidity, a sufficiently long period of warmth and not high, even summer temperatures.

Accordingly, the highest and most reliable yields of oats are secure within the boundaries of the northern non-black-earth belt and in the forest-steppe, not expanding as far north as barley and winter rye, due to its later ripening. Here, the role of oats is particularly important in the areas of mixed forests and forest-steppes, where the Swedish fly curtails the distribution of spring wheat and barley. At the transition of the forest-steppe into the steppe, oats begins to suffer considerably from lack of moisture and its yields here become unsteady.

In growing selected varieties, a better quality grain (characteristically less filmy, larger, etc.) is guaranteed rather by the humid north than the south, but it has to be mentioned that for export, the grain from farther south -- Central Black-Earth Oblast, Northern Ukraine and Central Volga, Tatarsiya and Bashkiriya -- is more valuable due to its purer color, resulting from the great amount of precipitation in the north during the harvest, making a grain which is more or less "maranthaceae).

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Our steppe-covered south with its enormous plowed areas and longer field work periods will be mechanized sooner than the forest-covered north, where the horse will be retained for a longer period. The grain growing south will find for the work animal the necessary fodder besides oats and will be able to utilize the surplus feed grain locally without overloading transportation facilities. And oats, which are needed in the north, in that location give the best results on both yield and quality of grain. Thus, considering these circumstances it is necessary, in the regionalization of this crop, to carry out a basic push northward and thus liberate the southern area for more valuable crops.

This will cause a considerable decrease in area under oats, which will have to be compensated for (together with all the measures for raising the yield of oats) by a distribution of oats in the north, which will yield a gross grain harvest which is high enough in relation to needs. This has to be considered particularly in connection with the fact that in the north, the prospects for oats will be more limited than before, partly because of the introduction of crop rotation, and partly because of the priority introduction of a number of basic crops, subject to expansion, like clover, flax, hemp, potatoes, beer-brewing barley and grain barley, etc., all of which will push oats in the crop rotation to the most unfavorable position. In connection with all this, within the boundaries of the non-black-earth north and the forest-steppes, oats have to be maintained, in the majority of regions within the grain group, as one of the basic crops in terms of the size of the area. Its importance can decrease in the extreme north, in the subarctic regions, in the relatively dry region of poor sand soils of the Oka-Volga Rayon and the western sand areas of Poles'ye, Ukraine, Belorussia and the southern part of the Western Oblast, where the podzolic sandy soils

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demand more frequent fertilization, and oats, as a crop first or second in requiring fertilizer, is less profitable in comparison with rye, clover, potatoes, etc., and can be of less importance.

The importance of oats increases considerably on the periphery of the Leningrad, Moscow, Urals, Kuzbass and other industrial areas, where a great number of horses is concentrated for short-haul transportation, in the lumber regions in Kareliya, Northern Kray, etc., as well as in the horse-breeding and border regions.

The great plasticity of oats in the sense of its adaptability to environments provides the possibility of a very easy maneuvering with the distribution of its plantings in accordance with the requirements of the country's economy, which keeps changing in time and space.

Barley

Having a very wide range of biotypes, barley, in some of its varieties, is a crop much more drought resistant than oats, which competes with it as a feed. It apparently suffers less from seizures in the south than does spring wheat. At the same time there are varieties which make it possible for barley to be a crop moving ahead of other grain crops to the north and into the high-mountain areas.

With the widening of the general barley planting area, and with the simultaneous even greater relative expansion of corn, another good-yield and valuable feed crop, barley's importance among other grain crops of the USSR will probably have to be decreased and the percentage of its sowing area reduced. The absolute decrease of area and reduction in barley production in the next years to come, is hardly desirable due to the following reasons:

Barley is one of our main export grain crops, being exported from our southern ports in very large quantities. As a beer-brewing product it is exported from the western parts of the USSR.

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Though corn cultivation is being developed, it can not completely substitute for barley. In the first place, it does not grow as far north as barley, and secondly, with the need for developing animal husbandry and hog raising in the country, barley has to become a crop additional to corn for the feeding of pigs not only in the northern areas but everywhere, in order to obtain a superior quality of bacon.

The example of our competitors on the international market -- Canada and the United States of America, where up to recent times, a very intense expansion of barley areas could be observed (in spite of mechanization and a decrease in work animals)--also indicates the correctness of the above deliberations.

In the USSR barley is cultivated for feed, food and for technical purposes. In the last respect, besides its use for beer and malt, barley is becoming more important in obtaining malt extract -- a product necessary for textile industry and for a number of other needs.

We have four main barley areas in the USSR: two in the non-black-earth north and two in the south.

In spite of the relatively small participation of the non-black-earth north in the general barley production, it is necessary to pay here considerable attention to this crop; first, because of barley's very great importance in the extreme northern belt, where, in connection with the exceptionally short growing period, this crop is the only one or the most important one among the food and feed grains. Secondly, emphasis is needed on this crop in connection with the fact that in some spots of the non-black-earth north, with a most even distribution of warmth and abundant humidity, there are concentrated the main areas of low-protein beer-brewing barley. Moreover, these areas are close to the nation's borders, which is very important for export. Not less important is barley here as a feed product for hog raising, and particularly

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in the potato areas. The potato and barley feed rations are a most advantageous combination both in effectiveness and in cheapness. It is necessary to consider also, that with the exception of the mixed-forest belt in the center and the east of the European part of the USSR, where the success of barley cultivation is considerably curtailed by the Swedish fly and for a number of other reasons, and with the exception of intensive flax areas, where due to the predominance of flax, barley can be given only relatively poor areas -- this crop, in terms of threshed grain, has in the north a higher yield than oats and is close to rye in this respect.

On the basis of biological particularities of the crop and the distribution of natural conditions, there are two northern barley areas: growing barley for food and feed, and the two row variety for beer brewing. When necessary, this latter type may also be used successfully for food and feed. The two zones may be divided roughly along the line (about 115 days non-frost period): Leningrad, Kadnikov, Soligalich, Kudymkor, Perm', Zlatoust, Irbit, Tyukalinsk, Novo-Sibirsk and the islands in the forest-steppe foothills eastward up to and including Krasnodar.

Optimum conditions for obtaining grain most satisfactory for beer brewing are in the abundantly humid, evenly warm area southwest of the Leningrad area, northwest of the Western Oblast and in the northern part of the Belorussian SSR.

Another beer-brewing barley area in the north is in the Kama region of the Central Urals ~~Basin~~ and Votkinsk Autonomous Oblast. ¶ Very little attention has been paid so far to this barley area, though its use is very important for the beer-brewing plants of the Ural, as well as for hog raising which is being developed here. The belt connecting these areas: the southwest of the Northern Kray,

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the north of the Moscow, Ivanovo, and Leningrad Oblasts and the north of the Nizhniy-Novgorod Kray, produce also high quality material, valuable for beer brewing as well as for grain. The grain of other northern areas is predominantly for feed, seldom for beer brewing and then of lower quality.

In the south of Belorussia and in the Poles'ye of the Ukraine barley is of lesser importance though it has good beer-brewing properties here as well as along the northern right bank of the Ukrainian forest-steppe. In the last mentioned region, barley areas have to be retained due to rather good beer-brewing properties, as well as because it is needed to supplement corn feed in hog and poultry raising.

The third barley area where it has to retain its great importance, only partly giving way to corn, is the arid steppe in the south and southeast of the Ukraine, in the Crimea, the arid part of North Caucasus and in the southeastern part of the TsChO. Here, due to high drought resistance, barley gives higher and more steady yields than oats, $1\frac{1}{2}$ - 2 times higher than spring wheat, and in the Crimea and the Prikum'ye, it competes with corn, which under the conditions of these regions, is a relatively low yield crop. This is an area in which barley, in terms of grain quality, is of a feed type and the area should, if possible, be retained for it in the interest of export (near ports) and to supplement corn for feed. Finally, in connection with spring barley, it is necessary to pay attention to some of the foothill areas.

In the mountainous part of Armeniya (Leninakan), record beer-brewing barley on a world's scale is obtainable, and therefore, its cultivation has to be expanded here by all means.

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It is necessary to pay attention to the expansion of winter barley cultivation not only in the suitable sections of the Trans-Caucasian and Central-Asiatic republics (in cases when the grain crops should not be pushed out by cotton), but also in the arid parts of the North Caucasus and the Crimea, which have sufficiently mild winters insuring wintering of the crop, and a hot summer. Under these conditions, it produces high yields and has quite good beer-brewing properties.

In other areas, barley can retain a limited importance. In the central regions of European USSR (the following applies also to spring wheat), barley so far does not have sufficient grounds for expansion, due to a number of yet little clarified reasons and partly due to injuries caused by the Swedish and Hessen flies. In the east and southeast, barley can not compete successfully with spring wheat.

Thus, the wider feed and technical use of barley in the reconstructed economy of the USSR is forcing us to pay much more serious attention than before to this crop, particularly in these areas: arid southern, abundantly-humid western, the ^{Kama}~~Petkamsky~~ and far northern regions.

Corn

Considering the increase of corn production as very important, the expansion of its basic plantings should be adapted to areas guaranteeing safe yields sufficiently high and steady.

The climatic factors which are supposed to determine (following the decisive aspects of a social-economic nature) the areas of corn farming specialization are: higher or lower precipitation (particularly in July), length of the non-frost period which determines the possibility of using corn varieties of higher yield, but requiring a longer growing period and, finally, sufficiently high temperatures

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during the growing period. The great aridness of the climate in the southeast (as well as the shortness of the non-freeze period and the deficiency in warmth at the northern borders of corn expansion) creates the need for earlier-ripening varieties which escape the seizure during the blossom and ripening periods, marked with high temperatures and low relative air humidity, which occurs here frequently in July and August; and which happened in some parts of the North Caucasus in 1930.

In connection with the above-mentioned and comparing our conditions with the "corn belt" of North America, we consider the so-called "zone of adequate humidity" in the North Caucasus as an area most favorable for corn and corn-winter wheat farming (including soy bean and other more valuable technical crops, particularly sunflower). This zone includes the forest-steppes and steppes in the foothills of the former Kuban', Maykop, Armavir and Tersk Okrugs and also the autonomous oblasts of Adygeya, Kabarda, Osetiya, Ingushetiya and Chechnya. Characteristic for this zone is the ripening of late varieties of high yield capacity, though in some of its northern sections, as well as in the mountainous parts, it is expedient to give preference to early ripening varieties in order to start early after the corn harvest with the sowing of the winter wheat.

Not lesser yields (of quite late ripening varieties) are obtained in the Pontiac zone of Georgia, together with Abkhaziya, Adzharistan and Kakhetiya. However, in spite of that, corn should be replaced here as much as possible by fruits and more valuable subtropical crops.

Quite favorable for corn, but when using earlier ripening varieties, there is also the area of adequate humidity in the Ukrainian SSR -- the southwest part of the forest-steppes and steppes of the right bank of the Dnepr' (AMSSR, former Kamenets, Mogilev, Tul'chinsk, Pervomaysk Okrugs) --

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where raising corn, together with sugar beet, has to be of leading importance.

Corn should be of sufficient importance in the remaining part of the Ukraine's forest-steppes and in the southern parts of the forest-steppes of the TsChO, where the amount of precipitation guarantees a high yield, but the lack of warmth and the very short non-frost period requires early varieties which have time to ripen. Slightly less favorable, yet, areas adequate for corn cultivation include the semi-arid parts of the Ukraine's northern steppe and the neighboring parts of the North Caucasus. Here, corn areas have to be expanded not only because of the adequate yield possible, but particularly, in order to obtain a larger amount of feed for the development of hog raising and also in order to raise the yield of the grain cereal plantings which are to follow, in view of the fact that corn clears the fields of weeds.

Corn is not fully reliable in terms of its hardiness and yield in the southern arid steppe of the Ukraine and the Crimea, on the southern black-earth and brown-earth soils. But, an adequate expansion of this crop (while taking into consideration the above circumstances) is necessary here too, since corn is the most drought resistant of the grain cereals. This applies also to the arid zone of the Lower and Central Volga.

Exceptions are the particularly arid semidesert areas: the former Stalingrad and Pugachev Okrugs and the ASSR of the Volga Germans, the northern part of the former Astrakhan', Trans-Volga part of the Kamyshin as well as the adjoining particularly arid parts of the Ural'sk, Sal'sk, Stavropol' and Tersk Okrugs. For these areas, even corn is not sufficiently drought-resistant, and is susceptible to seizures while blossoming. Corn, moreover does not adapt itself well

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to saliferous soils. Accordingly, it is not a reliable crop here, giving a low yield which sometimes is even lower than that of barley.

In the northern, transition to forest-steppe, part of the Central Volga Kray, the expansion of the corn area is desirable, but low precipitation, deficiency in warmth and the shortness of the non-frost period are limiting factors. Accordingly, it is possible to use only the most early ripening varieties, which, however, usually are not sufficiently high in their yield capacity.

It is extremely desirable to expand the plantings of corn in the spring wheat area of the Lower Volga and the steppe part of the Central Volga, but we assume, that here, more than in any other corn area of the USSR, the solution of the corn problem will depend on the right tempo of mechanization in its cultivation, particularly in harvesting.

A few words are in order on the possibility of corn cultivation in West Siberia and in Kazakhstan. According to empirical data at our disposal, corn may be grown in the southern part of the former Troitsk Okrug, in the central part of the Kustanaysk Okrug, in the Slavgorodsk, Rubtsovsk, Semipalatinsk, and Minusinsk Okrugs, but only by using particularly early-ripening varieties which, however, produce low yields of small grain. Besides, the low growth of the plants hampers mechanical harvesting on large areas and therefore it should not be considered expedient -- at least not in the near future -- to push this crop to any extent into these areas.

Millet

At the present time, millet cultivation is adapted to the most divergent areas of the USSR. Large areas in the Central Black-Earth Oblast, in the Ukraine and in other regions are occupied by it instead of by more valuable crops. In spite of millet's high yield in these

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areas with good climatic conditions, we assume, that in terms of planning it makes sense to carry out the concentration of mass planting of millet mainly in the arid areas of the USSR, where this crop, being more drought-resistant, can have a higher and more constant yield, in comparison with other crops. Such are the enormous spaces of the particularly arid steppes of the Trans-Volga and Kazakhstan which have brown soils that specialization in millet could be carried out there as an insurance against the less steady spring crop wheat yields.

As to the TsChO and the Ukraine, the millet plantings can remain there only on small areas, inasmuch as this grain might be needed in some parts of these oblasts for development of the poultry industry.

Buckwheat

Buckwheat plantings require a sufficiently humid climate -- in order to avoid seizures while blossoming. Buckwheat gets along with a short growing season if there is no threat of premature frost. Keeping in mind that buckwheat gets along quite well with poor sandy soils, it could be possible to adapt its plantings in the future basically to the abundantly humid areas of the southern part of Belorussia and the Ukrainian Poles'ye, predominantly sandy soil areas, and to the poorer soils of the Bashkirian foothills. This would lower buckwheat's relative importance in favor of other crops in the program of expansion onto richer soils.

Here it should be considered, however, that due to the taste of buckwheat groats they usually are preferred to millet, which up to now enjoyed an exceptional preponderance in the choice of cereals. Therefore, from the point of view of improvement and introduction of diversity into the nation's nutrition, it seems expedient, at any rate, not to diminish the absolute area of buckwheat planting, not only in the

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above-mentioned humid and warm optimum buckwheat areas in the European USSR, but also in the West Siberian and East Siberian Krays and the Asiatic Far East, even if the yield will be sometimes lower than that of millet. According to former crop distribution methods, when the success of and interest in a crop was determined by the stability of its plantings, this was of interest for the improvement of nutrition. Yet, since this was a crop which required moisture, of course, it could not compete with drought resistant millet, which on account of the conditions of nature, had greater possibilities for expansion.

LEGUMINOUS GRAIN CROPS¹

The species, types and varieties of agricultural plants grouped together under the general name of "leguminous grain crops" are quite diversified. Here are included the comparatively well known and widely used crops of peas, kidney beans, lentil, and vetch, and crops which up to recent times were less prevalent: beans, lupine, chick-peas, vetchling, serradella, Phaseolus mungo (a bean), and, finally, a number of crops reintroduced into the USSR: French lentil, velvety beans, cowpea, pigeon pea and others.

All these crops accumulate protein, which is a most valuable nutritional substance. Depending upon a number of properties pertaining to the various species and crop variations, crops may be used in many ways: for food -- as cooked ripe and green seeds; for feed -- as crushed seeds, flour, green bulk hay, for silos, for land enriching, for export and, finally, for processing for canning.

The need for increasing the protein food of the population, the exceptionally sharp protein deficit experienced in the feed rations of the various types of animal husbandry, the need for green fertilizer

¹ This section on leguminous grain crops is compiled by L. I. Govorov.

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and the enormous possibilities for expanding export, dictate the necessity of all-out measures for the most urgent expansion in the USSR of areas under leguminous grain crops.

The diversity of species, types and varieties of leguminous grain crops, with the exceptional range of their ecological particularities, makes it possible to cultivate individual forms of these crops from the northern agricultural borders to the subtropics of the USSR.

Considering the country's growing need for different ways to use leguminous grain crops, the area under these crops has to increase during the coming five-year plan, both in its absolute size and in its relative proportion to the total sowing area. The needs of the different branches of the USSR socialistic economy can be satisfied, if the plantings of all the leguminous grain crops reaches at least 10 percent of the total planting area. We shall limit ourselves below, to defining only the principal crops of the leguminous grain group.

Pea

This is the most widespread crop of the leguminous grain group, due to the fact that it is not demanding upon soil and climatic conditions. Its cultivation for green forage, for silage and for soil enriching, is possible at the northernmost agricultural borders. On the swampy and heavy loamy soils of the northern oblasts and krays of the USSR, the growing period of the pea is drawn out, and often the pea does not ripen completely. Accordingly, growing it successfully in the taiga-swamp zone for seed is possible only in elevated places. The pea's southern limits reach the southern black-earth varieties where it changes into chestnut black-earth. The low precipitation (for May-July below 175 millimeters), the considerable

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damage caused by the pea weevil "brukhus" and the successful cultivation of the southern competitors from among the leguminous grain crops -- kidney bean, chick-pea and vetchling -- all serve to limit the southward expansion of pea growing. The maximum range of pea cultivation areas are: Poles'ye and the right bank of the Ukrainian SSR, the entire TsChO, with the exception of its southeastern steppe part, and the right bank of the Central Volga Kray on black-earth and podzolic soils. These regions of relative density in pea plantings have to widen their areas at the present time and during the coming years, in order to meet the growing demand for large-seed export types (of the "Viktoriya" type).

Besides that, peas are of local importance for food and for supplying animal husbandry farms. Pea growing must be expanded in all the oblasts and krays of the European USSR, beginning with the northern black-earth varieties of the northern forest-steppe zone and extending northward to the southern regions of Kareliya and of the Northern Kray.

Consideration must be given to the tremendous possibilities for expanding pea planting areas in the Trans-Urals and in Western and Eastern Siberia, beginning with the subtaiga zone on the podzols and the black-earth of the forest-steppe, particularly in the southern parts of the former Tomsk and Krasnoyarsk Okrugs and in the former Achinsk Okrug.

The absolutely small areas of pea plantings in the Trans-Caucasus mountainous regions and in the arid soils with sufficient precipitation in the foothills of the Central Asiatic republics has to be expanded.

Lentil

In comparison with pea, lentil requires more warmth and less moisture. Its northern limits of cultivation in the podzolic zone reach not higher than the 57 degree north latitude. In the Predural'ye, (East Ural) Zaural'ye, and in the Southwestern Siberia, its border runs through the (West Ural)

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forest-steppes along the areas with a May-July precipitation of not less than 140 millimeters.

The basic and at the same time the optimum planting areas with prospects for further expansion of large-seed export lentil are the right bank of the Ukraine SSR, the northeast part of the TsChO on rich black-earth, on the right bank black-earth of the Central Volga and Lower Volga Krays and in the Tartar ASSR.

An expansion is needed of the areas of small-seed types for food and feed supply in the podzolic zone to which the large-seed types adapt themselves to a lesser degree, in the southern parts of the Moscow Oblast and the Nizhniy-Novgorod Kray, in the Ivanovo Oblast, in the former Aleksandrovsk, Vladimir and Shuysk Okrugs, in the Ural'sk Oblast, in the former Perm', Sverdlovsk and Zlatoust Okrugs, in Southwest Siberia and in the former Barnaul and Novosibirsk Okrugs.

Vetch

For green fodder and hay, vetch makes the same demands upon climate and soil as does the pea. The areas of these crops almost coincide. In the northern sections, vetch cultivation for hay has the advantage, its green bulk drying more easily, compared with the pea.

The northern border of vetch cultivation for seeds runs slightly south of the Minsk, Pskov, Smolensk, Moscow, Vladimir, Izhevsk, Ufa, Troitsk, Tyumen', Tara, Novosibirsk line. The optimum areas for obtaining good quality grain, covering the domestic requirements of the USSR and the needs of export are: TsChO, with the exception of the southeast part, the southern and southeastern rayons of the Western Oblast, Poles'ye and forest-steppes of the Ukraine SSR, southern part of the BSSR and the western corner of the Central Volga Kray. Cultivation for seeds has to expand northward into the southern half of the Moscow Oblast, in the southern parts of Ivanovo Oblast,

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Nizhniy-Novgorod Kray and the Ural'sk Oblast, in the central part of the Western Oblast and in Belorussia.

In Siberia the areas of degraded black-earth and clayey soils in the forest-steppe zone (which have a May-July precipitation of 160-200 millimeters) can be considered as safe for vetch seed cultivation.

Kidney bean

This is a crop which requires more warmth and gets along with the 100-150 millimeter precipitation of May-July. As a field crop the northern boundaries for growing lentils are: the southern part of Belorussia and the northern border of the entire black-earth zone. In vegetable farming, the early varieties can move northward up to and including Leningrad. The most favorable areas are: (1) TsChO, with the former Rossoshansk, Ostrogozhsk, Belgorod and Borisoglebsk Okrugs; (2) forest-steppes of the right and left banks of the Ukraine SSR; and (3) the North Caucasus Kray in the zone of sufficient humidity. It is necessary to move kidney bean cultivation northward; into the southern half of the BSSR, into the right bank black-earth zone of the Central and Lower Volga Krays where there is sufficient humidity. The drought-resisting kinds of the *Phaseolus acutifolius* type, have to be pushed forward into the Trans-Volga areas. It is necessary also to increase plantings in the Ukraine SSR steppe areas. Particular attention should be paid to the increase of kidney bean plantings in the Trans-Caucasus: in level places -- bush varieties -- and in the mountainous part (up to 1300 meters) -- climbing varieties grown together with corn. It is just as necessary to have kidney beans in the vegetable areas of the Central Asia republics.

Lupine

This is the best land-enriching crop for sandy and clayey soils which have sufficient moisture. Up to the present time its cultivation

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for green fertilizer was limited to the BSSR, separate spots in the Western Oblast and the sandy soils of the Ukraine SSR. The next expansion region is the enormous area of sand and sandy loam fields, beginning from the west along the northern border through Polotsk, Smolensk, Serpukhov towards Vladimir and Nizhniy-Novgorod, and in the South, from Zhitomir along the northern border of the black-earth zone. Lupine fertilizer should be provided and mixed with the sandy soils of the northern non-black-earth zone, in the individual rayons of West and East Siberia. Lupine plantings for fertilizer are possible also on the Trans-Caucasus tea plantations. Particular prospects are open to non-alkaloid lupine, both as a fodder crop and for food.

To insure the protein balance in regard to food and fodder, decisive steps must be taken to expand the area growing "forgotten crops", such as beans, chick-pea and vetchling.

Beans

Beans make slightly more demands upon soil than the peas and vetch and they require more moisture. Only the temporary lack of seeds of the early-ripening types hinders the forward movement of this crop up to the Leningrad Oblast. The regions next in line to receive this crop are Western Oblast, Moscow Oblast, Nizhniy-Novgorod Kray and the Ivanovo Oblast. Considerable sowing areas should be developed in the Predural'ye^(West Ural) -- in the mixed forest zone -- in the Trans-Ural subtaiga zone and farther south, with May-July precipitation not below 175 millimeters. Fully satisfactory areas are: BSSR, right bank of the Ukraine SSR and the TsChO, with the exception of rayons with precipitation below 175 millimeters during May-July. It would be very expedient to keep and if possible, to expand sowings in Tadzhikistan, and in the mountain areas of southern Pamiro-Alay.

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Chick-pea

This is an arid area crop. It is susceptible to fungus diseases when there is an excess of humidity. The areas for expanding sowings of chick-pea should be the chestnut black-earth steppes of the Central and Lower Volga Krays and of the North Caucasus, the steppe part of the Ukraine SSR, the Crimean ASSR, the foothills of Dagestan, the dry farming areas of the Central Asia republics and the arid areas of Trans-Caucasus.

Vetchling

Special measures are needed in order to expand its planting areas. As a crop more drought-resistant than pea and vetch, it is not subject to injury by weevils, requires less warmth, and, in comparison with chick-pea, it produces higher yields of seeds and more green bulk. Vetchling should occupy the in-between areas, between pea and vetch in the north, and chick-pea, bordering in the south upon the arid sections. As areas of its penetration can be identified briefly as semi-arid steppes of the Ukraine SSR and of the Central and Lower Volga Krays.

Among the new leguminous crops deserving attention in the practice abroad and producing quite successful positive results in experimental plantings in the USSR, are the following crops:

Serradella

Rightly called the "clover of the sand fields", culture suitable for green feed and for land enriching. Its cultivation areas almost coincide with those of lupine.

Velvet Beans

Unsurpassed as green bulk in combination with corn for the humid subtropics of the USSR.

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Fertilizer and a natural soil thickener for poorest swampy and loamy fields under subtropical conditions.

French lentil

The most drought-resistant crop of the entire leguminous group. It has to be introduced to the farms of the Kazak^hstan and other Central Asiatic republics.

TECHNICAL CROPS

It is necessary to pause here in order to clarify the most suitable areas for the cultivation of technical crops, such as flax, hemp, soy-bean, sunflower and also potato. Brief summaries and their more detailed development on the cotton plant, sugar beet and new technical cultures are in the second volume of the Plant Cultivation in the USSR.

Flax

The experience of many centuries shows the northern forest zone to be the main location for growing flax for fiber. Such adaptation of fiber flax is conditioned by its basic requirements of natural environment: cool climate, evenly humid, with an even distribution of warmth during the growing period. The amount of humidity as an essential regulator and the distribution of warmth is here apparently most important. As to the amount of active warmth, judging from the fact that within our flax zone boundaries we observe a steady improvement in fiber quality going from south to north, one is compelled to think, that here (if we are not seeking a continuous supply of completely ripe seeds and best quality fiber) the limiting minimum in warmth more likely will be rather in its surplus in the south than in its insufficiency in the north. As to soils, it is difficult to determine some one definite variety among the great number of them.

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On the whole, it is noticeable that the highest yields and fiber of best quality are obtained from structural clayey varieties and silt soils, as well as from new soils, resulting from forest clearings. The requirement for fertility is here not less important than the requirement for soil structure and the requirement that it be free from weeds.

In connection with these basic requirements of flax fiber, the geography of the fiber properties receives quite definite zonality, approaching the latitudinal division. Within the industrial flax-growing zone, according to the State standards, we have a fiber of lower grade on the sandy soils of the warm southern part of Belorussia and a better grade on the clayey soils of considerably colder Vycheгда-Sukhonskiy Rayon. The intermediate groups are located between these rayons, relative to the zonality of temperatures and precipitation. In correspondence with the indicated demands of flax, the best conditions for it in the USSR are in the northwest and in the maritime area of the Far East Kray.

In the west of the USSR there are old tested locations for raising high quality flax, which have created their own well-known strongholds, typical in fiber properties and in flax varieties developed there. Such areas are, first of all: All-Union Pskov Sanctuary, Vologda Rayon, Votsko-Vyatskiy, Yaroslavsko-Tverskoy, Smolensko-Tverskoy and Kostroma-Vladimirskiy Rayons.

Socialist agriculture introduces a number of additions and corrections into the existing geography of fiber-flax plantings. First of all, the collectivization and creation of continuous flax block areas together with a specialization of rayons, expulsion of crops competing with flax for better areas and furthering crops which stimulate flax yield (clover and other grasses in the flax-dairy and dairy-flax areas, etc.) facilitates a considerable increase in the planting acreage of flax

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in tested areas. Mechanization of harvesting and primary processing, chemicalization and the fight against so-called flax-fatigue of the soil, improvement in cultivation techniques and in harvesting, makes it possible also to gather and work up large additional quantities of soaked flax straw. Particularly great is the importance of mechanized cultivation and processing of flax in the areas new for flax in the sparsely populated rayons in the north of European USSR and in Siberia. The labor volume required by this crop and the low amount of working hands, put the brakes on the expansion of flax there. The tractors and flax-pulling machines, plants for primary processing operated on Angarstroy current, the electric power projects of the Yenisey, Kuzbass, Ural, etc., have to create new flax areas not less important than the old ones.

The possibility of having large electric power installations makes it possible for flax to conquer little developed areas, with good quality fiber, in the southern half of the Northern Kray as well as in areas which so far have extremely little to do with flax, as: the north of Predural'ye, the entire zone of subtaiga and northern forest-steppes of Siberia, from the Urals to Baykal and the Amuro-Ussuriyskaya lowlands in the Far East Kray.

Fertile clayey soils, devoid of swamps, of the subtaiga and forest-steppe zone of Central and Eastern Siberia in the Achinsk, Krasnoyarsk, Kansk and Irkutsk Okrugs, and the quite favorable climatic conditions of this zone, produce an excellent quality fiber and serve thus as a good concentration place for the use of Angara and Yenisey power. No lesser possibilities in that respect are the coniferous woods and the forest-steppes of the Trans-Urals and Western Siberia within the borders of the former Tarsk, Barabinsk, Tomsk, Novosibirsk

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and Barnaul Okrugs (particularly the Maslyaninskiy, Cherepanovskiy, Leogstayevskiy and Zalesovskiy Rayons, where the conditions are so favorable, that the flax long ago started spreading speedily of its own accord). Enormous flax yields are obtained in the Ussuri-Amurskiy, Khabarovskiy Rayon of the Far East Kray.

At the same time, for the future there is no zone limit for fiber flax, and in the European section, it is slightly south of its present limit: in the degraded black earths of the TsChO. This is indicated by the success of our selection in producing varieties resistant to fungus diseases.

In this forest-steppe belt and farther north in the belt of broad-leaf forests, there is a very meagre variety of cultivated crops, due to the prevalence of Swedish fly and for other reasons. In the near future, the intermediate types of flax can be grown successfully, predominantly for oil and also for a lower quality fiber. According to the geographic test data of the VIR, fears that fat content would drop with the advance movement of flax, have turned out to be groundless. The iodine content, moreover, increases.

The cultivation of flax (*brevimulticaulis*) for seeds is possible everywhere to the south, but in order to obtain greater yields and better quality oil, it is more expedient to move this crop southward and eastward. Its best areas should be considered to be the arid steppe parts of the Lower Povolzh'ye, North Caucasus, West Siberia, Kazak^hstan and the mountain areas of Central Asia, where the flax for linseed oil does not compete with any other more valuable crops. Thus, in comparison with the former distribution of flax plantings, the following changes are possible: to increase cultivation in the old flax-growing areas at the expense of farm collectivization, specializing

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in and mechanizing cultivation; to increase emphasis on growing flax for fiber, expanding the growing area into the northern part of the European zone, with special emphasis on obtaining quality fiber; to advance fiber flax into the subtaiga zone and into the northern forest-steppe belt, east of the Urals to the ocean, making use of the growing power potential; to make more intensive use of the zones of intermediate types of flax by planting mildew resistant, selected varieties; and, finally, to concentrate the formerly dispersed plantings of flax grown for flaxseed, relating this to the distribution of other oil-producing plants in the southeast part of the USSR.

Besides establishing a more accomplished social-economic basis, increasing power installations and the development of mechanization, other factors have to reflect on the success of flax cultivation expansion and concentration and on its higher quality: the fast increasing possibility of extensive use of mineral fertilizers, and as to influencing the plant itself -- the already obtained good results through our selection of high-quality flax varieties, immune to fungus diseases and with high yield of fiber or oil. Here should be mentioned also the successfully developing production of flax seeds which supports the possibilities of the fiber flax industry movement northward where the seeds often do not ripen, and the "vernalization" of flax, which will be of great importance, especially in the same direction of conquering northern areas, producing better quality fiber.

Hemp

The coarseness of fiber and the lesser value of hemp oil does not diminish our interest in this crop, particularly during the coming period which is characterized by the necessity of doing away with dependence on imported fiber (manila, jute, sisal, etc.) and of increasing

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to the maximum the production of coarse fiber, in accordance with the demands of agricultural mechanization which is developing rapidly (bags, twine, rope, etc.), the developing fishing industry (netting), the growing fleet (rigging), etc. From here follows the need for a greater increase in hemp production with its corresponding distribution by rayons.

The basic factors determining hemp production, from the point of view of its demands upon natural factors, are the weather conditions and the fertility of the respective areas. Basic minimum biological demands apply very sharply to hemp which is particularly sensitive to the length of daytime, to temperature and to the general characteristics of weather aspect during the first 1 - 1½ months (June is the critical month) of growth. A short day and a low temperature below 15 degrees greatly slows plant development and lowers yield. The exceptionally high demands upon nutrition represent the second biological minimum of hemp.

It is not clear yet how important for the successful development of hemp is the organic substance of manure, for data of the TsChO experimental institutions and those of the Western Oblast, definitely indicate very high significance in this respect to be found in mineral fertilizers. Large doses of mineral fertilizers, peat and green fertilizers are very effective; which makes it possible to take hemp out of the special hemp field into the homestead plots and into the fields.

Thus, in the future we shall be able to satisfy the requirements of hemp's second biological minimum. More than that, according to the data of the same experimental institutions, abundant fertilization in a great measure weakens the importance of the first minimum -- weather conditions, which enables us to fight the climate as well. Hemp's third

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minimum is its high susceptibility to injuries in some areas from the corn moth (*Pyrausta nubilalis* Hübner) and broom rape (*Orobancha ramosa* S.).

Hemp broom rape tends to develop more south of our hemp-growing sections and less to the north, where the incidence of seed ripening falls rapidly. It has been observed, that damage from broom rape drops off considerably as hemp is supplied with abundant fertilizer.

Judging from the geography of properties of the obtained fiber, it should be assumed, that successful hemp cultivation is considerably influenced by a number of other factors of economics and natural character. There is no doubt that in every respect the importance of variety is considerable. Among the factors determining the optimum of development is certainly the humid type of summer with an even temperature, characteristic of the best hemp growing areas.

The geography of hemp fiber properties, according to the government standard, which reflects to a large extent (with the former primitive methods of cultivating and processing the bleached hemp straw) the general ecological environment of individual areas, mentioned among the best: Pridesninskiy Region and the area of the upper Dnepr (1st quality rope -- most of the southern part of the Western and Ivanovo Oblasts, the western part of the TsChO and the Chernigovshchina in the Ukraine), further (2nd quality rope and first quality twine) central part of the TsChO and southern BSSR. Inferior material was produced in the central Volga forest-steppe and in other more continental areas.

With the various types of hemp, the natural area of its possible and profitable cultivation expands considerably. The less valuable hemp, in terms of fiber quality, but earlier ripening North-Russian hemp has a different range of biological minimum requirements, and it can advance northward almost as far as field cultivation goes. The late-

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ripening Italian hemp which gives a very profitable yield and an excellent quality fiber and other late varieties of hemp, on the other hand, according to the VIR data, can ripen even for seed in the North Caucasus, in the south of the Ukraine and in the Ussuriyskaya lowlands of the Far East Kray.

Accordingly these characteristics of the crop should be considered together with the fact that the crop's maximum growing area extends neither as far as the northern border of the fiber flax zone nor as far south as the zone of other technical crops. Thus, this crop does not compete with other valuable crops, but on the contrary increases the worth of the ordinarily small number of crops in the forest-steppe region. The basic hemp areas which should be noted are: the southern Belorussia, northern Ukraine, the southern part of Western Oblast, the western and central parts of the TsChO, with their high and even precipitation and a sufficiently warm spring with long days. In this hemp region which goes south into the flax region, fiber production should be mechanized not less for hemp than for flax, particularly during the period from the moment crops ripen up to the time that fiber is obtained. Chemical considerations here should be the basis for expanding production. On a smaller scale, hemp can grow also along the southern border of the flax-fiber zone. Late hemp varieties with high quality fiber should be used in the humid parts of the southern Ukraine, in North Caucasus and in Primor'ye in the Far East Kray.

We expect here much from the physiologists, who have to find a way to shorten the growing period of this valuable variety. This period should be shortened at least enough so as to get the seed to sow to grow the fiber for the coming year. With vernalization, it would be possible to push late-ripening hemp far to the north.

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North of the flax growing zone is another northern hemp zone, which should be mentioned because of its local importance. Here, even as a secondary crop, the hemp can become of great industrial value in the regions of large rivers and lakes with their fish industry and navigation. We refer particularly to East Siberia and to the areas of the national minorities (Khakas, Buryat, Yakut, Tungus, etc.), where, in the forest areas, large quantities of cow manure is hardly used, neither in the field nor for heating purposes.

Soy-bean

The soy-bean crop which should be considered very important requires special attention in order to properly locate its growing area. Its demands upon precipitation and temperature are similar to those of corn, but it requires a greater amount of precipitation particularly during the period of blossoming and ripening, since it is a plant of the monsoon climate.

We presume, that the most favorable regions for soy-bean cultivation (besides the Far East, where the possibility of wide expansion is quite certain) are in the zone of sufficient humidity which is the same zone as for corn in North Caucasus, but more in the foothills of the autonomous oblasts, in the former Armavir, Maykop Okrugs, and to a slightly less extent, on the Kuban'. Steadier and higher yields than in other areas where soy-bean is now grown are obtained here as well as in the humid rayons of Georgia) due to sufficient precipitation and warmth.

Soy-bean cultivation yields considerably inferior results in the steppe parts of the former Kuban' and Armavir Okrugs and in the autonomous oblasts, in the so-called "zone of unsteady humidity". In this zone which has lower precipitation and frequently lower air humidity in July it sometimes happens that the plant suffers from

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heat seizure while it is still ripening. Accordingly, earlier ripening varieties are needed than in the zone of sufficient humidity. Quite favorable for the expansion of the soy-bean area is also the southern forest-steppe and steppe of the Dnepr's right bank, but only if early ripening varieties are used. In a lesser degree it refers also to the southern part of the left bank forest-steppe, where its cultivation is possible but only with the introduction of earlier ripening varieties.

We consider it would be unstable and hardly expedient to grow soy-bean for seed in the semiarid northern steppe of the Ukraine, as well as in the analogous low yield areas of the former Don, Donets, Sal'sk and northern part of Stavropol' Okrugs of the North Caucasus. One should restrain from suggesting the arid zone of the Lower Volga chestnut soils, the southern steppe of the Ukraine and the Crimea, and the northern part of the former Tersk Okrug for soy-bean cultivation, since precipitation there is not sufficient to make it a success. In West Siberia and in Kazakstan the attempts at soy-bean cultivation are still in the experimental stage in the southern foothills of the more humid parts of the former Rubtsovsk and Semipalatinsk Okrugs. It is too early to speak of the possibility of its cultivation here.

All that was said above about soy-bean cultivation for grain, does not exclude the expediency of planting it for green fodder, hay and silage in a number of areas besides the ones mentioned, as, for example, in the steppe part of the Ukraine and in the TsChO.

Sunflower

In order to expand the cultivation of corn and soy-bean in the North Caucasus, the area under sunflower in the "zone of sufficient humidity" will have to be somewhat decreased, all the more so, because

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a considerable part of its area is seriously affected by broom rape, since plantings are made too often in the same place. There are sunflower varieties resistant against one type of broom rape. Against the so-called "bad" type of broom rape which is widespread in the North Caucasus and partly in the TsChO and in the eastern steppes of the Ukraine, the resistant varieties have been noted only in the most recent years, and accordingly, they could not be widely available. From the point of view of natural conditions, some decrease of sunflower plantings in the North Caucasus is quite possible, since its cultivation can be considerably expanded instead in the Lower and particularly Central Volga region, as well as pushed into new areas of black-earth steppe and into the further south parts of the forest-steppes of the Trans-Urals, of Western Siberia and of Kazakhstan.

Sunflower requires a shorter growing period than corn and it is sufficiently drought resistant. That is why, for these areas, it is a row crop no less valuable than corn. Besides, there are at the present time very early ripening varieties, grown by the Steppe station of the VIR (dwarf variety), the Saratov and Omsk stations. Reproduction of these varieties should be pushed ahead and the eastward advance of sunflower cultivation should be furthered, under these circumstances, and by all means. It will be particularly expedient not only because of its plantings being distributed on new lands, less endangered by broom rape, but also because it will introduce a row crop in this region which needs it badly in order to clean the fields of weeds, substituting clean fallows for spring wheat.

Potato

The potato growing area must be greatly expanded in connection with the following considerations: the increased rate of vegetable

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consumption, animal husbandry development, development of potato processing in starch-molasses and distillation industries, for the manufacturing of denatured alcohol, motor alcohol and synthetic rubber.

One of the basic factors in the distribution of potato planting areas is the cumbersomeness of transporting potatoes, the spoilage and the great losses from shipping. Thus, it is particularly necessary to plant potatoes as near as possible to the places of consumption. Due to this factor, it is necessary to establish potato growing areas where industrial population is concentrated, in animal husbandry areas where the feeding is based on local fodder supplies other than potatoes and, whenever expedient, in the localities where enterprises have already been established for processing potatoes, where this is sensible.

Establishing new animal husbandry regions based on potato feeding, as well as new processing enterprises, has to be done while taking into consideration an expedient area distribution of the crop in the sense of making maximum use of its characteristics.

In comparison with other crops, potatoes are exceptionally cosmopolitan, there being a great multitude of varieties which increases their general ecological flexibility. Within the USSR, they can be cultivated successfully on a large scale as a vegetable crop, entering the tundra and the arid steppes and making use of peat-swampy and sandy soils of the abundantly humid north.

However, due to cultivation demands, not all the areas are of equal importance. Among the most important conditions for potato raising are the following: the length of the warm frost-free period, allowing time not only for a complete growing period, but also for

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safe harvesting without too much effort, which is particularly important in uninterrupted mass planting areas, especially before the complete harvest mechanization takes place. The development period has to be characterized by moderate temperatures, not high and not low, and by a great amount of precipitation. Potatoes are particularly sensitive to precipitation, which limits their success in the arid steppe regions of the south and east. The humid mountainous sections of the south, however, present very favorable conditions for potatoes. All this has to be taken into consideration in the areas where our sanatoriums are located, which up to now are not sufficiently provided with potatoes. The soils should be preferably light, sandy loam or clayey (but not structureless), black-earth or podzolic soils with sufficient fertilizer added. When well fertilized, even sandy soil is suitable if it is not dry or if it does not have a low level of ground water. The most clearly expressed embodiment of these conditions we have in the west of the European part and to some extent in the Primor'ye in the Far East.

Finally, a no less decisive factor in the distribution of potato crops is the spreading of diseases, though the regulation of this factor is at the present time to a great extent in the hands of man. We must indicate as particularly favorable conditions in this respect those of our coniferous forests in the north. Unfavorable conditions are found in the south of the European part and in the northwest (south and west of the Leningrad Oblast, north of the BSSR, etc.). Other areas are in an intermediate position.

In terms of all these properties, the northwestern part of the Ukraine, the southern part of the BSSR and of Western Oblast with their long growing period, humid and evenly warm summer, light soils, average exposure to diseases, and, most important of all, in the absence of more valuable crops which need these sandy soils, these

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areas are of great interest for growing potatoes. For the same last mentioned reason, it is just as important to grow potatoes on the sand soil areas of the humid zone along the Oka, Klyaz'ma, Unzha, etc., in the Moscow and Ivanovo Oblasts, along the Unzha, Vetluga, Vyatka, Volga and Oka Rivers in the Nizhniy-Novgorod Kray, etc.

Corresponding with all these considerations, the basic potato areas of the USSR have to be distributed within a close radius from the country's industrial centers in the zones of accumulated sands, and in the belt of the abundant humidity in the western section of the European area, in the humid Far East Kray, in the alluvial pasture areas of dairy animal husbandry and hog breeding in the northern non-black-earth zone of the USSR, and in the areas where potatoes are processed into starch, molasses and alcohol (mainly in the TsChO, Moscow Oblast, Ivanovo Oblast, BSSR, etc.).

The use of agrotechnical and physiological methods which speed up the process of tuber ripening, the practical solution of the problem of growing seed potatoes, as well as that of tuber storage under the conditions of the polar north, must make it possible to have a reliable potato supply for our northernmost areas of industry and other enterprise.

Due to the fact that in the south potatoes are significantly susceptible to the so-called infections of degeneration, and because of the difficulty of making frequent deliveries of seeds for replacement, extensive practical experimentation should be made particularly in the maritime section of the south, with growing sweet potatoes, which are prevalent in areas of comparable conditions in America.

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FODDER CROPS

Red clover¹

One of the most widespread fodder crops with great prospects for further development in the USSR, is red clover, an irreplaceable bean-family perennial fodder crop for the entire north, for the major part of the non-black-earth belt's central zone and for some areas of the northern black-earth belt of the USSR.

The maximum range of red clover crops should be considered to be those areas where summer precipitation during May-July is not below 175-200 millimeters. The approximate border line of such optimum areas of red clover in the south follows along the Poles'ye's southern border in the Ukraine, through Kursk, Voronezh, Tambov, Penza, north of Kazan', along the northern border of the Tatar ASSR, and in the Bashkir ASSR -- through the Ufimskiy, Birskiy, Myasogutovskiy and Sterlitamakskiy districts. Moreover, particular areas may be singled out in the humid zone of the Caucasus. In Siberia in the Biyskiy Rayon, the steppe section is not included. The area does include the foothills of the Altay. In the north, almost the entire Leningrad Oblast and the southern part of Northern Kray will form the border of the optimum regions for growing red clover.

Within the optimum conditions for the clover zone mention should be made of sandy soils, unfavorable for red clover cultivation. There, clovers can be grown only after the addition of an adequate amount of manure or mineral fertilizer. Mention also should be made of the swampy soils, where clover can be developed effectively only after

¹ Written by the fodder crop section of the VIR. Here are given deliberations in regard to the distribution of two fodder crops offering the greatest possibilities in the field cultivation in the USSR.

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adequate reclamation work has been done. Red clover can be grown as far north as field cultivation is possible, where under the snow cover, it winters fairly well.

Drought hinders the southward expansion of red clover, and the yearly isohyet of 450 millimeters closes up from the south the areas where the crop is reliable and worthwhile to grow.

The winters without snow in some parts of the European and Asiatic USSR are ruinous to the wintering of red clover, particularly for the variety which is reaped twice. In West Siberia red clover growing can be considered safe only in some subtaiga areas.

Red clover growing hardly reaches East Siberia, beyond the Yenisey, since the continental climate is unfavorable to the growth of this crop.

Up to the present time, we do not have red clover varieties in quantities suitable for industrial uses. It is true that by sowing the same seeds for tens of years, some local red clover types have been developed in a number of areas; among them are the more widespread and more valuable single harvest -- Perm', Ufa (clovers of the Bashkir Republic), central Russia, Yaroslavl', Pskov clovers and the twice reaped -- Ukraine, Kursk and other clovers.

The two basic types of cultivated red clover, for double and for single reaping, have their separate areas where they are widespread. The area of the two-crop clovers is in the southern parts of clover growing regions. One-crop clovers are in the northern sections. The area of the one-crop clovers is about twice as large as that of the two-crop clovers and in the future it will be the most rapid to expand.

Between the two above-mentioned mass distribution areas, there extends the belt of mixed clovers, where both types of clover are equal in importance and in their quantitative distribution.

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Up to the present time clover seed production was dispersed all over the clover planting areas, with the exception of the extreme north. The basic areas for the commercial production of seeds are in the Ukraine, the TsChO, Nizhniy-Novgorod Kray, the clover rayons of the Bashkir ASSR and Urals Oblast, as well as in the Biyskiy Rayon (without its steppe section) of West Siberia. It will be necessary in the future to develop the most favorable areas for clover seed production and to determine the main clover hay producing areas.

Observations indicate that excessive fall humidity unfavorably influences the seed crop of red clover. The slightest lack of humidity (July-August 140 millimeters) during the second part of the growing period, on the other hand, creates rather favorable conditions for seed production. It should be mentioned, that in American practice high yields of clover seeds are obtained in arid areas under the conditions of irrigation. Thus, clover seed production for the market should be concentrated in areas with a sufficiently dry autumn, in the southern and southeastern sections of clover growing areas.

Blue alfalfa

In the USSR, this is a crop whose growing region as yet has not been clearly defined. Almost in all the countries where alfalfa is sowed, it expands its areas at the expense of other less valuable agricultural plants. We see striking examples of this in North America, Argentina, New Zealand, South Africa, etc. The same will soon take place in the USSR where an enormous expansion of areas is outlined for blue alfalfa crops.

The wide adaptability of alfalfa to the most variegated soil-climate conditions, its easy and speedy evolution to narrowly defined types and varieties, often highly adapted to wintering, drought resistant

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and immune to a number of phyto-pests: all these considerations taken together make it imperative to increase the area under alfalfa.

Even now we find large alfalfa areas in different longitudes and latitudes of the USSR, beginning with the south, the irrigated rayons of the Central Asia and Trans-Caucasus republics and then, through the dry steppes of North Caucasus, the Crimea and the Ukraine -- to the forest-steppe, the TsChO and the Volga region. Alfalfa has expanded considerably also in the forest-steppes of West Siberia and it is moving on to the Far East Kray. We know further of alfalfa fields in good condition at individual locations in the Leningrad and Moscow Oblasts and in some other rayons, north of the Moscow Oblast.

One of the main factors helping blue alfalfa to conquer new areas is its facility to hybridize with yellow alfalfa. As a result of these hybridizations, valuable species and varieties are obtained, which not only retain all the best and important particularities and qualities of blue alfalfa -- like yield capacity, speedy growth and tenderness -- but acquire the frost and drought resistance of yellow alfalfa which further facilitates the expansion of blue alfalfa cultivation. To a lesser degree, the same particularities are obtained by some of the blue alfalfa strains exposed to the effects of natural selection. These biological particularities of alfalfa strains and varieties are seen clearly in the following examples:

During the extremely severe and snowless winter of 1928-29, in the USSR, in the Ukraine, at a VIR station near Khar'kov, the percentage of destruction by frost of some blue alfalfa strains was as follows:

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Percentage of freezing out
of blue alfalfa

Alfalfa from Egypt	- - - - -	100 percent
" " Provence	- - - - -	58.00
" " Semirechinsk	- - - - -	34.00
" " Canada	- - - - -	30.00
" " Armeniya-	- - - - -	26.00
" " Ukraine (left bank)	- - - - -	10.50
" " Khiva	- - - - -	10.20
" " Yellow	- - - - -	0.00

Thus, alfalfa can expand from the extreme south to the far north, and the limitation to its cultivation is not frost, but rather, excessive humidity, soil erosion and the nearness of moisture in the subsoil. Besides that, other fodder grasses are beginning to compete with alfalfa in the north. Red clover, for example, produces seeds farther north than does alfalfa.

Extensive cultivation of hybrid alfalfas, valuable due to their characteristics in relation to frost and drought and their high seed productivity, will drastically widen the areas of blue alfalfas in the USSR. Growing the best yellow alfalfas will permit alfalfa to enter those regions where up to now it was not possible to hope for large alfalfa areas.

We are informed that yellow alfalfa grows near the Arctic Circle in Alaska, in the Yukon River Valley, beyond the 64th degree of northern latitude.. What main strains and varieties of blue alfalfa do we have now in the USSR and what place can they occupy? According to our observations, the best strains of blue alfalfa of those

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in the world, are the following: Alfalfa from Provence, "Matboro" from New Zealand, Hungarian, Franconian from Germany, Ukrainian from the left bank and blue from the state of Kansas in North America.

The best of the hybrid group are: the whole "Grimma" group from North America, alfalfa "Ladak" and finally, alfalfas grown by the Krasnokutskaya experimental station. Best among Asiatic alfalfas for the watering conditions of the Trans-Caspian republics are, so far, the Turkestan and Turkmenistan varieties. In the Trans-Caucasus, in places where there is now a local irrigated alfalfa and in not high areas with arid soils, the alfalfa from Provence and Hungary can be developed. High arid soil areas have to grow the highly resistant creeping Armeniyan alfalfa.

The southern foothill areas of the North Caucasus can grow alfalfa from Provence and Hungary. In dryer areas of variable humidity, these alfalfas have to give room to the Ukrainian alfalfa which is gradually being displaced farther to the east, in the arid steppe region, by hybrid and yellow alfalfas. The dry steppes of the Crimea and the southern steppe of the Ukraine can grow the hybrid and Yellow alfalfas.

The yellow and hybrid alfalfas are gradually being replaced towards the forest-steppes by the Ukrainian alfalfa, which can spread beyond the Ukraine northward to the TsChO and the forest-steppe sections of the Volga region. Hybrid alfalfas can be grown still farther north. In the more arid sections of the Volga region, with severe winters, hybrid and finally yellow alfalfas should be spread.

As to West Siberia, its forest-steppe region can be occupied by the Krasnokutskiye alfalfas and by Grimma, while south, towards Kazakstan, groups of hybrid alfalfas, close to the yellow ones and the yellow ones themselves should be grown.

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In the Central Asia republics, so far, Turkestan alfalfa can stay, which is highly valued in North America due to its injury-resistance (particularly valuable is the alfalfa from the Chimbay Rayon), and farther south -- the endemic alfalfas of Turkmenistan.

Seed production of the above-mentioned alfalfas in the areas of the USSR which are most favorable will prove to be a very important practical measure to free our country from foreign dependence.

NATURAL CONDITIONS AND ZONES OF FIELD CULTIVATION

NATURAL REGIONS IN THE USSR

As a basis for dividing the USSR into natural regions, there have been taken the particularities of climate, soil, relief and natural vegetation, the distribution of which represents to a considerable degree the summarized influence of the basic natural factors, inasmuch as they have not yet been changed by the human being. For this purpose were used vegetation maps by N. I. Kuznetsov, soil maps by L. I. Prasolov, as well as a great number of other data listed in the supplement to the first volume of the "Plant Cultivation in the USSR". In considering factors of climate, attention is given principally to those which can have direct influence over the success of cultivation or desirability of one or another area distribution of field crops. The aridness of climate was determined by total yearly precipitation, by the total of May-July precipitation (decisive for early spring crops), July-August (for late crops) and, finally, the mean relative air humidity in June (at 1:00 p.m.) which is of an essential importance for the successful blossoming and ripening of cereal grains. The mean July temperature, the total warmth of the growing period and the length of the non-frost period are taken as indicators for the possibility of pushing crops requiring one or

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another temperature regime and length of growing period. Finally, the mean January temperature and the depth of snow cover at the end of winter are taken into consideration as indicators to a certain degree, which show whether it is feasible to grow winter crops or perennial plants (grasses). The data for the registration of climatic factors is from maps and writings of the Agrometeorology Department, some of which is printed in this study, and other sources.

In determining the regions, the particularities of soil were everywhere taken into consideration. In many cases, the soil zones and regions naturally fitted into the climatic ones, as deriving from the latter (see supplement 2). Together with the description of natural regions within krays and oblasts, which is in the second part of this work, concrete data is given on each region.

In general, the entire USSR (with the exception of the Trans-Caucasus, whose regionalization is described separately), according to the combination of all those natural conditions which are reflected in the particular direction to which field cultivation tends, can be divided into the following main natural zones, combining a certain number of the indicated regions:

Zones with a Particularly Short Period of Warmth

Arctic zone of forest-less tundra and forest-tundra with shrubs and stunted trees, lichen, moss and sedge swamps, poorly developed soils in the permafrost zone.

The extremely short growing period and small amount of warmth exclude the possibility of extensive agricultural development. However, the long days and non-setting sun in summer can be widely used for growing early vegetables in covered ground and, on light soils, on elevations with southern exposure. This can compensate considerably

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for the lack of warmth in growing potatoes, frost-resistant grasses and oats-barley mixtures.

The warmer estuaries of large rivers carrying fertile soils which cut through the tundra, are covered with abundant bottom land vegetation. Agriculture here first of all must overcome the following factors: shortness of the warm period, winters with low temperatures, little snow and exceptionally unfavorable soil conditions. At the same time, there are a number of factors which should be directed towards furthering the development of plant cultivation. Among them are: about two months of continuous light of the polar day, an extremely large amount of wind power, tremendous peat deposits which could be used successfully for heating and lighting hot houses. The nature of soil-climatic conditions implies first of all the need to develop vast pastures.

Near-arctic zone of northern coniferous forests in the European USSR, in the northern, also considerably swampy, West Siberian taiga and in the dryer northern taiga of East Siberia and the Pacific Ocean Kray. A cover of moss predominates in the forests, and in the wide river bottom lands. There is peat and there are poorly developed podzolic soils, considerably lixiviated in the west, weakly, in East Siberia. Fertile alluvial soils are along the rivers. The climate, in comparison with evaporation, is very humid, causing considerable swampiness. There is a small amount of warmth and a short growing period (on the average, less than a hundred frost-free days), which is enough, however, to insure the development of grasses, potatoes, turnips, barley, hemp and flax for fiber. Severe winters with relatively little snow, nevertheless, make it possible to grow winter rye, but only in the west, and puts a limit to the clover growing area.

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More favorable conditions for field cultivation are along valleys and terraces with lower-level ground water or layer of permafrost, with a natural run-off of surface waters. These grounds are more easily warmed up, are protected against wind, and in the valleys of large rivers, they are partly warmed from proximity to large water masses. Among the rocky, little-developed and peat soils of the "Scandinavian shield", especially in the west, but also farther east, a good soil background is provided by grassy lowland swamps, the use of which should have top priority. Little-developed soils require abundant manuring which, from an organizational point of view, makes the organization of dairy-vegetable farming very expedient.

By choosing early and frost-resistant crops and varieties it is possible to make use here of the positive characteristics of the humid climate, particularly in the direction of obtaining a large bulk of vegetatives. However, the short summer and long winter make very categorical demands upon technical and mechanical equipment, relating partly to harvesting and canning (tractor-mowing, drying, filling silos and storing vegetables).

With great opportunities for using cheap peat and wood fuel and with the heat energy of electric power plants crops can be grown which need a lot of warmth. Vegetable growing can be developed considerably more on open ground and with the use of less complex and expensive installations than in the preceding zone.

High-mountain zone. This zone has various characteristics in different mountainous areas depending upon their geographical position and elevation above sea level. There is the belt of perpetual snows or bald mountains covered with mountain-tundra vegetation, sub-Alpian and Alpian meadows, mountain-forest, mountain-steppe and non-forest rocky areas. The zone stretches in a long belt from the Central Asia

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desert in the southwest to the mountainous tundras of the Chukot peninsula in the northeast, covering the major mountain systems on USSR territory. Due to the expanse and diversity of geographic relief, the climate and soil characteristics in different parts is very heterogeneous. The high mountain systems in the west of the zone, situated in more southern latitudes with a less continental climate (Caucasus, Altay) have a richer and more luxuriously developed vegetation, including broad-leaved forests and Alpien meadows. Less high mountain systems of the continental East Siberian elevation (Sayany, Yablonovyy, Stanovoy, Verkhoyanskiy ridges, etc.) have in lower stages mountain-taiga and mountain-steppe characteristics, with permafrost. The severely arid mountain country of Pamir with a continental climate has mountain-desert characteristics.

The severe conditions of climate and undeveloped soils in the mountain zone make agricultural development seldom possible, adapting it mainly to the exits of river valleys and limiting its choice of crops to those requiring least warmth and the shortest growing periods. Places more suitable for agricultural development require reclamation -- clearing of passes and pastures, banking the slopes, protection against soil erosions, etc. In many places the small amount of snow in winter makes it possible to have winter pastures.

Forest Zones (not including the northern taiga).

Zone of southern coniferous forests in the central forest belt of the European USSR with a rare participation of broad-leaf tree species and broad-leaf grasses, with large areas of moss swamps. The soils are on the whole considerably podzolic, frequently swamped and swampy; clays, clayey, sandy loams; along rivers often pine forest sands; in river valleys -- alluvial soils with vast bottom lands. High humidity of climate, length of non-frost period (100-130 days) amount of summer heat and winter characteristically severe but with much snow.

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This makes possible the growing of clover, large assortment of cereal grasses, tubers, potatoes, high quality flax and gray cereal grains. With normal applications of fertilizers, exceptionally high and steady yields of these crops are insured. In comparison with the preceding zone, the vegetation of waterless valleys is developed much richer; which together with more extensive possibilities for grass sowing the development of meadows becomes much more important.

An extensive, simpler, and successful use of new lands developed from forest clearings is possible with clearing done by forestry units, at the same time making extensive use of power installations for field cultivation (tractor pulling, primary processing plants using forest scrap, etc.).

Zone of mountainous coniferous and coniferous-leafy forests of the Ural and ("chernevaya" taiga) of the Kuznetskiy Alatau and Altay. The soils are strongly or weakly podzolic, rocky; in the zone's southern parts, there are degraded black-earths. Conditions of good humidity though sometimes with a rather short frost-free period (100-120 days), in spite of everything, are adequately favorable (with added fertilizers) for the cultivation of crops, potatoes, vegetables, early-ripening grains, among them spring wheat, particularly in the Altay section and in the "south of the Urals" region.

The uneven terrain in places makes an environment favorable to the development of fodder growing in field cultivation. On the whole, however, the area is better suited to the development of a pasture-forest economy.

Zone of mixed, coniferous-leafy forests in the European section and in Siberia. In the European USSR -- mixed forests with large number of broad-leaved species. Heterogeneous podzolic soils,

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many huge loam areas, sometimes with considerable humus content.
Low swampiness (except the western part).

The most favorable area of northern agriculture -- large amount of precipitation, long frost-free period (110-140 days) makes it possible to cultivate the USSR's best flax, clovers and a large number of other fodder crops, gray cereal grains, beer-brewing barley of high quality, and in some places -- winter and spring wheat.

In the Siberian section of the zone, there are partly swampy coniferous forests (the so-called "urmans" and "sub-urmans"), partly in timber areas in the south, where there is an admixture of birch and aspen. Soils are considerably swampy and podzolic. The climate is humid, with a frost-free period long enough for successful cultivation of flax, potato and oats. In the south, there is spring crop wheat. The snow cover guarantees sufficiently steady clover and rye cultivation. In the southern part of the zone, the Swedish fly is widespread.

Very favorable agricultural conditions and the presence of a large number of industrial and electric power centers just in this zone of the non-black-earth north, create a more favorable environment for the speedy adaptation of vast lands, more extensive use of electrification, mechanization, chemicalization and the development of a large scale economy. Just here, with specialization of field cultivation and an increase in yield, conditions are suitable first of all for regulation and an increase of production in this basically "consuming zone". An abundance of humidity, with an already high amount of heat and with good response of soils to fertilizers are factors which should be made use of by agriculture, especially. Agricultural success depends in many cases on an excess of soil moisture as well as

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on atmospheric precipitation, particularly at the end of the summer and in the fall. Soil drainage and crop protection against putrefaction are here, therefore, necessary conditions for agricultural development.

Abundantly humid zone of mixed forests of the western type and of pine forests on podzolic, sand, loamy sand and clayey soils.

The long frost-free period, with the greatest amount of warmth in the non-black-earth area. The character of the soil and of the evenly warm and humid climate make possible a very successful cultivation of clover, flax, hemp, grain and beans, beer-brewing barley, winter crop wheat and the crops of loamy sand soils -- potato, lupine, buckwheat, etc.

An abundance of moisture and an already very long growing period make it possible to cultivate a wide assortment of particularly moisture-requiring field crops and late, high-yield varieties. Limitations are provided by large block areas of poor sand (and in the southwest also swampy) soils, which, however, respond very effectively to fertilizers, among them green fertilizers.

Zone of mountainous broad-leaf forests (oak, white beech, beech) on mountainous forest and podzolic soils of the Caucasus and the Crimea. Abundant humidity, mild winters, sufficiently long frost-free period, are favorable for the cultivation of winter wheat, corn and tobacco.

Zone of southern broad-leaf forests of the Black Sea shore and the Crimea, with a particularly mild climate, large amount of warmth and the longest frost-free period in European USSR (200 and more days) makes it a region for fruit growing and southern technical crops.

Forest-Steppe Zones

Transitory to the forest zone, the northern forest-steppe with leafy-tree groves and large islands of broad-leaved forests on degraded

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and lixiviated black-earths of the European USSR. In climate and possibilities of field industry, there is quite a similarity to the southern mixed forest zone, but with more favorable soils. The effects of the Swedish fly are very considerable, which is rather limiting to the cultivation of spring wheat and barley.

Forest-steppe (meadow steppe) with islands of broad-leaf forests (groves) in the European USSR. Rich fertile black earths. Due to the vastness of this zone, from the Dnepr's right bank in the southwest and up to the Ural foothills in the northeast, the climate is different in different parts of the zone. In the Ukrainian part of the zone, the sufficient humidity, the rather long frost-free period, and a mild winter are favorable for the cultivation of winter wheat, sugar beet, and corn. The less mild winter in the TsChO makes the winter wheat a less reliable crop. The shorter growing period gives first place among row crops to sugar beet and not corn, but sunflower. Presence of the Swedish fly does not permit a successful spring wheat and barley crop. Finally, in the forest-steppe of the Central Volga left bank region and the Bashkir ASSR, severe winters, in spite of an abundant snow cover, as yet make it impossible to grow winter wheat. The amount of precipitation, though considerably lower than in the southwest section of the forest-steppe, is sufficient for a reliable spring wheat crop, and the length of the frost-free period permits growing early-ripening sunflower varieties in advanced areas.

The transition to forest zone ("urman") meadow solonchak forest steppes in West Siberia (Baraba, Tarsko-Ishimskiy Rayon) on swampy and partly saline soils of floodland strips. Sufficient precipitation and a lowlands location provides favorable conditions for the formation of natural meadows and pastures for growing fodder, fiber flax and -- on better lands -- even spring wheat.

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Northern forest-steppe of the West Siberia type, with frequent birch groves ("kolki") on dark gray podzolic soils among steppe areas on podzolic, saliferous and lixiviated black-earths. Unsteady humidity, but usually sufficient for good wheat crops; favorable also for fodder crops.

Foothill forest-steppe of the Trans-Ural, Altay, Kuznetskiy Alatau and park-like birch groves of the latter are distributed on regular and lixiviated (and partly fertile) black-earths. Sufficient humidity due to the mountains, with moderately-warm summers and good soil conditions guarantee good yields of spring wheat, fiber flax, fodder crops and this makes it possible to develop vegetable growing near the mining regions.

Shrub and rocky steppes in the foothills of the Altay represent a southward continuation along the Altay of the preceding zone; in which connection, they preserve, due to vertical zonality, comparatively good humidity, have a slightly warmer climate and a longer frost-free period. Therefore, besides wheat, sunflower growing is possible.

Southern forest-steppe of West Siberia type represents a transition to the steppe, with predominantly open steppe areas and birch groves here and there, but less frequently than in the northern forest-steppes. Soils are black-earth, partly saliferous and lixiviated (under "kolki"). The climate is more arid than in the preceding zones, is most suited to spring wheat, but it makes the yield not fully reliable.

Foothill forest-steppes of the North Caucasus on eroded and degraded black-earths. Due to vertical zonality, the humidity is sufficient, sometimes excessive. The warm climate with a long growing period (170-190 days) and mild winters, make this zone one of the best for field cultivation in the entire USSR. Natural conditions guarantee

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not only steady high yields of winter wheat, corn and soy-bean, but also of a number of southern technical crops as well. To these zones should be added also the mountain steppes, forest-steppe islands and the open taiga of the Predbaykal'ye, Trans-Baykal regions in the east, with heterogeneous soil covers from podzolic soils to fertile black-earths. The climate is characterized as extremely continental, with a short (100-115 days) growing period, not sufficiently humid or arid, with considerable sun radiation, a very severe winter and little snow. As to wintering, the Predbaykal'ye section is more favorable and in protected places winter rye is a crop which can be relied upon. On the whole, the climate makes it possible everywhere in this large zone (sometimes with irrigation) to produce spring wheat and oats and, in Predbaykal'ye, even flax. In perspective, field crop possibilities in this naturally rugged zone will be changing considerably in connection with the completion of the Angara River project. Large power installations applied to agro-technical developments have to be used in the fight against the severe climate, in compensation for the tremendous lack of manpower in field cultivation and for the exploitation and mastery of the taiga.

Steppe and Semi-Desert Zones

Priamurskiye, Priussuriyskiye and Zeysko-Eureinskiye meadow steppes on alluvial soils and podzolic mainly clayey soils of the lowlands. Located in the monsoon region with its warm summer with extremely abundant precipitation, but a dry spring. Winter in the greater part of the zone is cold without much snow. Within the Zeya-Amur lowlands, the growing period allows the cultivation of spring wheat, oats and in the southernmost part -- early soy-bean varieties. In the Ussuri River basin and Lake Khanka, with a warmer climate and

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a 120-150 days frost-free period, rice and soy-bean crops can be completely relied upon.

The type of winter, manifested in the considerable and deep cooling of the soil, the aridness of early spring as well as the abundance of fall precipitation in some places leading to soil swampiness, necessitates that adequate steps be taken to warm the soil, to humidify and improve it. The exceptionally abundant precipitation during harvesting, requires an extensive as possible power installation, harvest mechanization and organization of drying and other methods for crop protection against damage. The considerable development of fungus diseases, connected with the warmth of a humid summer, requires particular attention in the choice of agricultural crops and varieties.

Flooded lands on alluvial soils of river valleys and estuaries of the Volga, Don, Dnepr, Terek and Kuban' Rivers. Though the major part of them is in a more or less arid climate, the latter's influence is modified by conditions of good (and excessive) soil humidity. With adequate reclamation, the flooded lands can become an area for the cultivation of very valuable crops, depending upon temperatures of their geographic location, for rice and cotton in the south, and for fodder, vegetables and fruits, everywhere.

Zone of sufficient humidity in the North Caucasus with diversified grass steppes on fertile near-Azov black earths. Mild climate, abundant precipitation, a very long frost-free period (190-200 days) and rich soils, present in the zone (together with the foothill zone of the North Caucasus) particular possibilities for the development of southern technical crops, corn, soy-bean and especially a reliable yield of winter wheat.

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Zone of unsteady humidity in the North Caucasus, with diversified grass steppes on near-Azov black-earths. Climate similar to that of the preceding zone in warmth and length of the frost-free periods, suitable for cultivation of the same crops; greater fluctuations in annual precipitation, slightly lower than the mean, making yields somewhat unsteady.

Semiarid diversified grass steppes on regular (and in North Caucasus, the near-Azov type) black earths forming a belt south of forest-steppes, within the northern and eastern steppes of the Ukraine, the former Don Okrug of the North Caucasus, southern part of the TsChO, northwest part of the Lower Volga region and the central part of the Central Volga Kray and Bashkiriya. The general character of the zone is semiarid (125-175 millimeters of precipitation during May-July and 45-50 percent relative air humidity in June), and it causes a not fully reliable yield. The climate varies in different sections. The zone's western part (Dnepr's right bank region), due to the mild winter, is favorable for winter crop wheat cultivation; together with the rest of the zone within the Ukraine, which has a sufficiently long frost-free period, for corn as well. The part of this zone within the Ukrainian left bank region, North Caucasus and TsChO is -- due to winter temperatures and lack of snow -- not sufficiently reliable for growing the at present usual winter wheat varieties. There are great possibilities, however, for advancing this crop with new winter-resistant varieties. The semiarid steppe of the Lower and Central Volga region is risky even for winter-resistant varieties. This zone is sufficiently favorable for spring crop wheat and sunflower.

Arid diversified grass steppes on southern black earths forms the next belt to the southeast within the European USSR. A comparable

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belt stretches along West Siberia and Kazakhstan, from Orenburg to Kustanay, Kokchetav, and Slavgorod. The mean precipitation for May-July of 100-150 millimeters in some years is considerably below these figures, which, together with the low mean relative air humidity (average for 1:00 p. m. in June -- 45-50 percent) makes the yield of spring wheat with a good grain quality, the principle crop of this zone, unreliable. Winter wheat is destroyed by frost during the severe and snow-free winters.

Very arid southern feather-grass steppe on dark-chestnut soils of the Ukraine, Crimea, Prikum'ye and Dagestan with low precipitation (110-150 millimeters during May-July), hot climate and relatively low air humidity (only about 40 percent in June) has, however, a long frost-free period and a comparatively mild winter. These conditions create in this zone a region for the adoption of new technical crops (cotton) and the cultivation of winter crop wheats with highest quality glassy grains.

The very arid southern feather-grass steppes on chestnut soils of the Central and Lower Volga regions, the neighboring part of the North Caucasus and the analogous belt in the Trans-Urals, south of the line from Orsk to Atbasar, to the northern part of the Pavlodar Okrug and Semipalatinsk, demarcates an area of low precipitation (mean for May-July 75-120 millimeters), with a low relative air humidity (average at 1:00 p. m. during June, 38-45 percent), frequently falling below normal, which makes it impossible to have yields which are at all satisfactory. Therefore, the cultivation of even the most drought-resistant wheat varieties and such crops as millet is possible only at extreme risk, particularly in the Trans-Urals region.

Very arid hilly (of volcanic formation) semidesert elevated southern feather-grass and grass-^{mugwort}~~willow~~ steppes on dark and light

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chestnut soils, frequently of detritus characteristics. Also, a small amount of precipitation (in some places, slightly larger, due to elevated relief) and worse soils make agriculture without irrigation possible only in the most favorable places of the zone.

Very arid grass-^{Mugwort}~~woolgrass~~ semidesert steppes on light-chestnut, sandy-loam and sand soils in Kazakhstan (in the former Pavlodarsk, Semipalatinsk Okrugs) has all the unfavorable climate conditions of the preceding zones, plus unfavorable soil conditions.

Extremely arid grass-^{Mugwort}~~woolgrass~~ semidesert on complex light-chestnut soils with spots of solonetz. An extremely small amount of precipitation (mean for May-July 50-100 millimeters) frequently diminishing to a negligible amount, a sharply continental climate with hot summers (with an extremely low relative air humidity (June average: 35-40 percent, but frequently considerably lower) makes it possible to have field cultivation here only with irrigation or in deep ravines.

^{Mugwort}~~woolgrass~~-saltwort semidesert of the Kazakhstan and Kalmykiya, with an extremely arid climate (50-75 millimeters precipitation and lower, during May-July) and solonets and sand light-chestnut and brown soils -- unsuitable for agriculture.

Zones of Central Asia Republics South of Kazakhstan and Kirgiziya.

High-mountain ^{region}~~steppes~~ of Tyan'shan', Dzhungarskiy, Alatau and Tarbagatay. Alpine and sub-Alpine meadows, in some places fir tree forests. Mountain-meadow, gravelly-detritus, rocky soils. Due to climatic and soil conditions, agriculture is almost impossible. Pastures have a rich supply of fodders.

High-mountain ^{region}~~steppes~~ of the Pamiro-Altay. Vegetation is characteristic of the steppes. Instead of fir forests, there are

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chestnut soils, frequently of detritus characteristics. Also, a small amount of precipitation (in some places, slightly larger, due to elevated relief) and worse soils make agriculture without irrigation possible only in the most favorable places of the zone.

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High-mountain ^{region}~~steppes~~ of the Pamiro-Altay. Vegetation is characteristic of the steppes. Instead of fir forests, there are

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growths of saddle trees and leafy shrubs. Soils are more rocky. Due to climatic and soil conditions, land cultivation is almost impossible. It is a pasture area though inferior to the previous one considered.

Mountain and foothill steppes of Central Tyan'shan', Dzhungarskiy Alatau and Tarbagatay. In some places, there are growths of steppe shrubs and leafy trees. The soils are black-earth and chestnut, less often grey-earths, frequently gravelly-detritus. Semiarid and arid climate with a 250-600 millimeter yearly precipitation including a rainfall of 55-100 millimeters during May-July. Irrigation is possible to some extent. The summer temperature (22-24 degrees in July), and the length of the frost-free period (140-160 days) is not adequate for growing cotton. The region is one of grain farming and orchards.

Mountain and foothill steppes of the West Tyan'-shan', Pamiro-Altay and Kopetdag. The steppe shrub growths and leafy forests are more diversified than in the preceding area. Chestnut and gray-earth soils, often are gravelly-detritus. The climate is humid in winter and spring, but very arid in summer, with 250-1,000 millimeter yearly precipitation, including 75-100 millimeters during May-June. The July-September period has no precipitation. Length of the frost-free period (160-180 days) and the summer temperature (24-27 degrees in July) make possible the development of spring crop plants, which need an average length growing period. Winter crops can be grown, making use of winter-spring precipitation. This is an area of grain farming and fruit growing, and to some extent an area where arid-soil cotton and other technical crops are grown.

Foothill semidesert along the northern foothills of the Central Tyan'shan', around the Dzhungarskiy Alatau and at the southern foothills of the Tarbagatay. ^{Mugwort} ~~hermwood~~ steppe and irrigated lands on gray earths.

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The climate, in comparison with the 3rd zone is more arid, but warmer and with a longer frost-free period. With irrigation it is possible to cultivate early-ripening cotton in the south and technical and grain crops in the north.

Foothill semidesert along the foothills of the West Tyan'shan' and Pamiro-Altay. Desert steppe and irrigated lands on gray earths. There is a hot climate with mean summer temperature of 25-28 degrees and a frost-free period of 180-210 days. 175-400 millimeters is the yearly precipitation. Conditions are particularly favorable for raising cotton of the average early-ripening and average late-ripening varieties. This is a basic area for cotton growing.

Extremely arid and hot desert of West Uzbekistan and South Turkmeniya. The soils are desert type and "takyr" (firm loamy soil saturated with salt) type grey-earths, saline river deposits or "solonki". The climate is particularly hot, with a 28-31 degree summer temperature, and a 210-250 day frost-free period. Precipitation is 70-200 millimeters a year. Irrigation is indispensable. Conditions are favorable for the cultivation of late-ripening long-fiber varieties of cotton, among them, Egyptian cotton.

Dry subtropics of South Tadzhikistan, Southwest Uzbekistan and Southwest Turkmeniya. Desert steppe and irrigated lands on gray earths. The climate is particularly hot. This is in contrast to the preceding zone with milder winters. Mean January temperatures for many years have risen to zero centigrade and even to 2-4 degrees above zero, which does not exclude the possibility of a periodic occurrence of rather deep freezes of short duration, of as much as 15 degrees below and lower. Conditions are favorable for the cultivation of longer staple, lower-Egyptian varieties of cotton. In experimental

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cultivation, subtropical perennial crops also are being worked out.

River and lake lowlands of the lower Amu-Dar'ya River and South Kazakhstan. Black haloxylon growths, "tugaynyye" and solonchak shrubs, meadows and reed covered alluvial banks. Soils are "takyr"-like and partly saline. Climate divides the area into two parts:

(a) The lower reaches of the Amu-Dar'ya River -- with a hotter summer and a 180-200 day frost-free period. It is possible to raise average late-ripening, average early-ripening and early-ripening cotton crops;

(b) The lower reaches of the rivers in South Kazakhstan with moderately hot summers and a shorter growing period of 160-180 days. It is possible to grow rice and new fiber-bearing plants as well as alfalfa.

Most arid desert, sandy and loamy-gravelly with solonchaks and loamy "takyr". Soil and climatic conditions without the possibility of irrigation, makes land cultivation impossible. There are pastures for sheep and camel raising. The area is divided into two parts:

(a) Sandy deserts -- better provided with potable well water and with more of a variety of fodder;

(b) Rocky-clayey and clay-solonchak deserts -- very little well water and predominantly wormwood-saltwort fodders.

ZONES OF FIELD CULTIVATION

On the basis of the considerations in the preceding section on movement, advancement, expansion or decrease in plantings of different crops, in correspondence with general problems of the national economy and agricultural reconstruction, as well as in terms of the natural requirements of these plants in the particular regions described

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above, in supplement 6 we give listing of zones and subzones for field crops. In each of them, the general nature of crop raising (its specialization) is identified in terms of the basic crops which should soon be of predominant importance. Consideration is given also to those additional crops, which though unable to occupy large areas should be expanded, since their production is of particular importance.

Poor Agricultural Zones

1. The tundra-pasture arctic zone is located in the tundras and forest-tundras in the extreme north of the European and Asiatic parts of the USSR. The short growing period, the small amount of warmth, considerable swampiness, weakly developed soils and the presence of permafrost makes impossible a more or less important development of field cultivation. Only rare oases in river valleys and flooded meadows makes it possible to use the limited grass assortment to improve hay fields and pastures as well as for growing oats and barley together. Feed resources are represented mainly by natural pastures (lichen, swamp vegetation, diversified grasses of shrub pastures) and rare but very rich hay fields in bottom lands.

On covered ground, it is possible to grow various vegetables, mainly for greens. By using methods which speed up ripening in the more favorable protected locations which have light dry soils, it is possible to use open ground for planting early varieties of potato and turnips.

Use of an enormous amount of wind energy, of peat and coal fuel, of heat and energy from electric power and heat plants, for growing vegetables in hothouses, is a branch of activity which must become firmly established in places where there are concentrations of population

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of river and lake valleys, etc., and the water-divide swampy-forest lands, covered with a woods blanket of moss and the poorest of grass vegetation. There, in the mountainous pasture zone, swift mountain rivers do not form inundated meadows. Fodder lands are chiefly the dry mountain and valley pastures.

Farming possibilities from point of view of soil and climate conditions -- besides the geographic position of some specific places -- depend on the geographic relief and on the importance of vertical zonality in terms of climate and soils.

The high mountain Altay-Sayan subzone has forest pastures and Alpine pastures at the higher altitudes in places suited to farming. It has a wider variety of crops than the two more eastern subzones: the dry and continental East-Siberian (pastures, potato-vegetables, fodder crops, spring wheat, spring rye-oats) and the more humid Far Eastern (pastures, potato-vegetable, fodder crops, barley, rye, oats, spring wheat). These two subzones are of a mountain-taiga and mountain-steppe type.

In spite of the more continental climate within the latter two subzones with their more level terrain and wide valleys, there are possibilities for a relatively important development of farming in strips along the rivers (Tunkinskaya valley, Upper Lena, Upper Angara, Amgun', Ud, lower reaches of the Amur, etc.).

Generally speaking, the basis for agriculture in the zone is in making use of natural pastures and hay fields. The choice of cultivated plants is among very few. In various parts of the zone, it consists mainly of potatoes and vegetable crops in mining districts and of a combination of barley, oats, rye, and more rarely wheat -- in the more remote sections. Reclamation in order to clean up hay fields and

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engaged in industry and in other enterprises. Lichen cultivation, and in places where dairy farming is developed, the transformation of lichen swamps through reclamation (removing the moss cover) into areas of phanerogamae, will increase the number of reindeer which the pastures can feed and it will supply fodder for animal husbandry. Many bottom lands have not yet become part of agricultural economy. Of particular interest, is the problem of using waste from fishing, hunting, and trapping, from the production of hides, etc., as well as making use of a number of seaweeds, in order to obtain a combination of fodders and fertilizers.

2. Mountain-pasture, agriculturally poor zone. Stretching along the southern border and embracing an enormous territory in the eastern section of the USSR, this zone includes the Dzhungarskiy Alatau, Altay, and Sayan mountain ranges and the branched out orographical system of Pribykal'ye and the Pacific Ocean Kray. Tentatively, the dividing line in the east between the bottom land pasture zone (see next zone) and the zone of mountain pastures, is traced east of the Central Lena lowlands with its bottom lands and "alasnyye" hay fields. In some places, however, farther east, along the Amur, Ud, Amgun', Tym, on ~~the~~ Sakhalin, and in other places, the lowland bottom land type of landscape repeats itself, just as within the bottom land pasture zone, farther west, the mountain pastures of the northern Urals are included as well as the Tungus mountain range and several other ranges. The transition of the mountain-pasture zone into the tundra-pasture zone in the northeast is very gradual. Here in the mountains, branches of the tundra reach far to the south.

In contrast to plain bottom land pastures of the northern zone, where the main sources of fodder are the floodland and mainland meadows

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pastures, arranging better runways, establishing regulated pasturage and hay mowing, and selection of fodder grasses suitable to the different mountain districts, coordinating this with the development of large scale animal husbandry, making the proper selection of animal breeds: all this will make it possible to have a much more extensive agricultural utilization of this zone which, at the present time, is very little used.

3. Bottom land pasture, potato-vegetable, fodder crops, barley-rye zone. Colossal in size, this zone covers the northern coniferous forest belt of European USSR and the northern taiga in the Asiatic part. In the European part and in West Siberia, the zone is swampy and forest-covered. Areas suitable for field crops have been made into river valley terraces, which provide run-off for surface and ground water and make the soil less swampy and lighter "warm". The East Siberian section is not less forested, but it has less swamps and, unlike the western section, it has weakly podzolic soils, but with a considerably greater prevalence of permafrost. There usually are strips of sandy soil along the rivers. On the water divides, there are mainly peat swamps and usually more moist tenacious ("cold") soils. The rivers in the valleys, having collected a lot of water, and because they flow slowly, carry fertile alluvial soils which form flood meadows -- the zone's basic wealth. Bottom lands surround the lakes and swamps which overflow, while the swamps themselves, without improvement, have a vegetation of little value for fodder.

An interesting potential supply to be developed is in the fertile and easier cultivated lowland swamps, which -- with proper fertilizers -- give very high yields of oats (for hay and green

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fodder), timothy with clover and other feed crops. The forest cover is mainly moss; and the forest pastures are not very productive.

Severe winter, the short growing period and small amount of summer heat make it possible to cultivate only cold-resisting and early-ripening crops.

The agricultural possibilities of inundated meadows, as well as waterless and swampy pastures and hayfields, are not everywhere sufficiently realized, particularly when one considers that the size and productivity of these areas can be greatly increased. This can be done by clearing away the trees and bushes, by draining, by banking the bottom lands, restoring protective forest belts, calculated to keep the bottom lands clear in terms of the amount of water collected, the nature of the soil and ground, etc. In the same way, it is quite possible in very many places to improve the waterless pasture by replacing the moss cover by sowing grass. And by organizing a regulated cutting of hay and use of pasturage, this should improve considerably the quality of the fodder products.

It is possible to improve hayfields and pastures by additional sowings of a considerable assortment of perennial cereal grasses. Fodder resources can be increased by an extensive introduction of mixed oats and barley sowings and potato plantings. Potatoes and vegetable crops are becoming very important in the locations where mining and lumbering is under way and in the centers of the lumber industry. In connection with the extreme lack of roads and the remoteness of the zone, much attention has to be paid to grain crops, counting them among the necessary components of the grass-field-tuber and meadow plants crop rotations.

Basic among the grain crops is the earliest of them -- barley, farther south rye as well, and oats in the southernmost section, which

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is of basic importance in the lumber areas. In certain places spring wheat can be produced as a crop of secondary importance in the west, and as an additional crop in the east. It is necessary to grow peas, particularly the fodder variety.

Besides potatoes, everywhere in the southern section it is possible to grow some other crops for technical use: flax, hemp, white mustard, and winter ^{gold-of-pleasure} ~~crop flax~~ (Camelina sativa). According mainly to the amount of summer heat and the degree of climate continentality, the zone can be subdivided into four parts which are well characterized by the individual grain crops. The northern subzone is the most vast and coldest area with a shorter growing period (bottom land-pasture, potato-vegetable, fodder crops, barley). It occupies the entire northern belt of oasis farming in the European and Asiatic parts of the USSR. There are less possibilities for growing sowed grasses, especially in the continental east, where barley and potato are of greater importance.

More favorable conditions for all these crops are in the barley-rye-potato subzone located in the European part of the USSR. Wintering conditions here offer more reliability for crops of winter rye and perennial grasses.

Farther south, though under slightly more continental conditions, but in that connection, with more summer warmth, the subzone of bottom land-pasture, of potatoes and vegetables, fodder crops, and rye-oats-barley in the coniferous forests of the Trans-Urals and West Siberia can count among its basic grain crops rye and oats and a large variety of grasses.

Finally, the Angara and Upper Lena valleys in the east (bottom land-pasture, forage crops, wheat-rye-oats-barley subzone) have a

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decidedly continental climate. They have a summer with highly heated air and soil, yet, at the same time with very cold winters and little snow. There are very limited possibilities, specifically, for making use of the existing variety of fodder grasses. The adoption of speedy methods in selecting local and world-wide fodder grasses has to be done here without delay. In the grain crop group, spring wheat holds one of the basic places, together with rye and oats.

Due to the short summer, it is very important for the zone to introduce mechanization of fodder harvesting and arrange for storage of produce during the long winter. Tremendous bottom land areas are in many cases not yet utilized. Due to the lack of machines, many hundred thousand tons of hay and ensilage are lost even in the more populated districts. Their utilization could make it possible to develop extensively animal husbandry for dairy products and meat and to have enough supplies for raising reindeer, particularly in view of the frequent lack of fodder in winter. In organizing fodder-vegetable State farms, this matter can be developed here in the immediate coming years.

Zone of Flax and Fodder Crops

4. Bottom land-meadow, fodder crops, flax, oats-rye-barley. This zone is in the southern coniferous forest belt with a richer grass cover, in the southern relatively less swampy and more heavily cultivated section of the podzolic-swamp zone of European USSR. Besides less swampiness, this zone differs from the preceding zone of bottom land-pasture of near-arctic location, in having a longer growing period, a considerably higher amount of summer heat and a less severe winter. As there, field cultivation is concentrated chiefly within the huge waterless land areas along the rivers, but in consider-

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ably wider strips. Agricultural development is hampered by the abundance of forests and swamps, and the basis of agricultural development consists of making use of natural fodder resources and improvement of hay fields and pastures with specialization of cultivated areas also in the direction of fodder. In this connection, it is possible to decrease the relative area given to grain crops by increasing their yield and by having grain brought into heavily populated industrial locations.

Here, the assortment of crops suitable for cultivation is considerably more valuable and larger. In addition to perennial cereal grasses, grass sowing here has to be based mainly on clover (single reaping variety). Flax cultivation is possible everywhere, and the conditions of the zone's southern section are of particular interest in this respect, due to the high quality of fiber obtainable here.

The important place of barley is giving way to oats which is needed here in numerous districts of intense lumbering. Increased also is the absolute importance of potatoes and peas for food and fodder. In some places the early types of spring wheat find good conditions for development, which is very important for remote regions with difficult grain transportation facilities. Generally speaking, rye and oats are basic grains.

In the western zone section, the vegetable, potato-tuber, clover-oats subzone is of particular interest as a supply source for the Leningrad industrial district. Of basic value here are vegetables and fodder. With intensification of crop rotation and a decrease of fallows, and also because of a considerable concentration of horse raising in this industrial and border region, first place in the grain group goes to oats instead of winter crop rye.

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The adjoining swampy subzone to the east has a combination of crops which is typical for the zone: fodder crops, rye, oats, flax (in the south).

The subzone of the Vychegda, Dvina, Vaga and Onega is an inter-river area which has a transitional climate between north and south, between swamp-forests and podzolic-swamps. It grows clover-flax and rye-barley-potatoes, but due to the shortness of the growing period, having basically a fodder-flax combination of field crops, it should have, in its grain group, barley as a basic crop in addition to rye, expanding oats, however, in the rapidly developing lumber areas. The expansion of the lumber industry puts potatoes in one of the basic positions of importance as a field crop for the table, for fodder, and as a vegetable.

The moderately warm and less swampy Sukhovskaya subzone has very good prospects for an intensive development of flax growing with high quality fiber. This is a flax-clover, rye-oats subzone.

Similarly, in the neighboring Predural'skaya subzone, the natural conditions and the possibilities of a more rapid mechanization must bring about a more intensive development of flax growing. In connection with the great importance for the industrial Priural'ye (analogous with the Leningrad subzone) of oats in comparison with winter rye, field cultivation here basically consists of such crops as flax, clover, oats and rye.

The improvement of flooded and waterless valley hayfields and pastures requires, on the whole, the same measures as in the bottom land-pasture zone farther north. However, the more favorable climate and soil conditions make it profitable in many places to change the less valuable pasture and forest lands into cultivated meadows and

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plowed fields for a more abundant source of fodder. The zone's high humidity is most effectively used with the cultivation of fodder crops, but at the same time, the same abundant humidity requires the use of a lot of technical equipment for harvesting and for fodder storage. Lixivated soils are very much in need of chemicalization.

5. Flax-clover and oats-rye. This zone is located predominantly in the mixed forest belt in European USSR. Slight swampiness and an exceptionally favorable humid climate with an even distribution of warmth and precipitation and a mild winter, determine the basic field crop characteristics of this subzone. Here flax and clover are among the leading crops. Root tubers and silo crops, which have here much more extensive possibilities for future development, add considerably to the clover and cereal grass fodder assortment. Wintering conditions for grain crops not only guarantee highest winter rye yields, but make possible also the development of winter wheat. Oats, which like moisture and beer-brewing barley enjoy here the most reliable of conditions. The latter finds a place for itself particularly in the west, where the favorable characteristics of the zone's climate are more sharply manifest. Oats will be a most widespread component of the grain crops in the flax-clover and meadow crop rotations. Of the bean family it is necessary and possible to develop extensively food peas and fodder peas "peliushka", and in some places: horse beans, lentils, lupine and vetch for grain and seed.

Flax and clover, as well as a large assortment of other fodder crops, can be considered as a basic group everywhere in the zone. In certain parts of it, the following are distinguished: the great importance of beer-brewing and fodder barley in the more humid and warm western subzone (flax-clover-rye-oats-barley) and the great

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importance of potatoes in the central near the Volga industrial region. The other two subzones have a crop combination which is typical for the zone: flax-clover-rye-oats, with greater emphasis on clover and oats in the Predural'ye.

With the development of the net of machine-tractor stations and plants for primary flax processing, the density of plantings, greatly exhausting the flax soil, here will be quite considerable and the podzolic soils of the zone will need particular attention to chemical reinforcement. Similarly, due to the concentration of a large population and a large number of electric power and industrial centers, this zone, particularly within the non-black-earth north, has to be provided, first of all, with means for improving the cultivated areas, and for bringing wastelands into cultivation through reclamation. All this is needed in order to bring closer to the consumer the products of dairy and vegetable farms and to bring agricultural raw material to the factories and plants.

6. Rye-oats-wheat, flax-clover, and pastures. Analogous to the preceding zone of mixed forests in European USSR, there is a very narrow strip of mixed, coniferous-narrow-leaved forests in the Trans-Urals and West Siberia. Due to intense swampiness and a considerably more continental climate, the expansion of planting area is rather limited. At the same time, it is possible to develop flax and clover cultivation. Swamps, flooded meadows and waterless valley forest hay meadows and pastures further the development of dairy cattle breeding. To the basic grain crops -- winter rye and oats -- spring wheat is added, the natural conditions for the growth of which, improve rapidly as the crop moves south to the next zone.

Favorable conditions of a rather short but sufficiently hot summer, should be used for a more extensive preparation of the soil,

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particularly through reclamation with drainage. South of this is the zone which is transitional to the typical spring wheat zone:

7. Spring wheat, rye-oats, flax with subzones of potatoes and vegetables, and fodder growing in the regions of the Kuzbass and Angarstroy. Spreading over open taiga areas in the East and partly in West Siberia, over foothills and mountainous open taiga in the foothills forest-steppe of the Altay, as well as over meadow solonchak forest-steppes of north Baraba and forest-steppe islands of the Predbaykal'ye, this zone is sufficiently humid and spreads mostly over degraded and lixiviated black-earths, partly over forest, weakly podzolic and swampy meadow lands. Natural conditions as well as reliable and high average yields of spring wheat, are favorable for an extensive development of fiber flax plantings and for an expansion of fodder crops for the benefit of dairy farming. Enveloping the Kuznetskiy and Cherekhovskiy basins, this zone has to become the main supplier of dairy products, potatoes, vegetables and root tubers, as well as of bread for the working population of the largest industrial centers of the Kuzbass and Cherebass; at the same time it can use for its agricultural development the power potential of the Kuzbass, Angarstroy, etc. Oats have to be kept on here for horses in the mining and lumber industries and rye to lessen the load of work during the sowing and harvesting periods. More attention should be paid to the expansion of flax cultivation in this area which again is growing this crop. This applies also to growing ensilage and grasses (clover in the west of the zone, vetch with oats in the mountain and foothill sections, American couch grass and alfalfa, broom grass and sweet clover in the meadow-inundated river bank, forest-steppes and open taiga). Extensive cultivation of new lands (gained through forest clearings and

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reclamation of swamp areas) will make it possible to expand fodder crops, flax sowings and root tubers, without decreasing the areas under cereal grains and especially, wheat.

An enormous improvement of the soils for intensive cultivation, particularly on podzolic soils, will take place here with the help of nitrate fertilizers, which will be produced in tremendous quantities within the zone at the Kuznetskiye and Angarskiye plants which process coal.

Rye-Potato Zones

8. Rye-clover-potato zone. This zone is transitional to the broad leaf forest-steppe belt and the southern part of the mixed forest zone of European USSR. It has a more or less common soil basis of sandy loams and sands, but is climatically different in various sections. The abundantly-humid western part, covering the south of the BSSR and of the Western Oblast, can more appropriately grow the group of rye, clover, potatoes and hemp crops. The central, Moscow suburban area should grow vegetables, potatoes, root tubers, and a clover-oats combination. The eastern section is suitable for rye, clover and potatoes. Additional crops in some places are: oats, flax, peas, buckwheat, lentils and lupine. The need for an increase of winter wheat is to be noted. The forage assortment, besides grasses, consists of ensilage crops and among those, in some places are: corn, sunflower, beans and root tubers.

Being transitional to the grain growing south, this zone to a great extent together with the next one south which grows rye, oats and potatoes, must undertake the production of grain, particularly rye, in order to lower the grain deficit of the farther north flax and fodder zones. The presence of sandy soils and the relatively long growing

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period, with still good conditions for growing clover, call for developing hog raising and potato processing enterprises, using large quantities of potatoes. With the development of mechanized farming with the application of chemicals, very favorable conditions are created in the evenly humid western part of the zone for large area plantings of hemp. Mechanized sowing, harvesting and processing of these basically laborious crops, the application of chemicals, enriching the sandy soils with legumes, and expanding grass sowings: all this should be developed as the way to raise the productivity of field crops in this zone.

9. The zone of clover-potato-vegetables, oats-rye (Urals metallurgical zone). Stretching in a long belt of longitudinal direction along the Urals metallurgical district, this zone in different latitudes differs only in so far as the secondary crops are concerned.

Practically throughout the entire zone there is retained the production of clover, potatoes, vegetables, fodder root tubers and oats. In different places, there is barley, rye and wheat, depending upon latitude and the distance from the metallurgical centers. Forestry is very worthwhile on the cut-up terrain. There is difficulty and it is less expedient, under such conditions, to have mechanized farming for which there is little opportunity. The chief emphasis of farming here is on growing vegetable, fruit, berries and fodder for dairy herds. Stress is laid on developing the proper pasture crops and hayfields, and on obtaining fodder from cultivated areas.

10. The rye, oats and potato zone is in the area of the northern forest-steppes on lixiviated and degraded black-earths and, in terms of the relative importance of additional crops, it is divided into two subzones:

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(a) Rye-oats-potato-hemp in the southern sections of the Moscow Oblast, Nizhniy-Novgorod Kray, in the northern TsChO, in the Ukraine's Poles'ye, as well as in the former Penza Okrug and the eastern section of the Mordva Autonomous Oblast and the Central Volga Kray, and

(b) Rye-oats-potato-spring wheat in the former Ul'yanovsk and Syzran' Okrugs of the Central Volga, parts of the Tartar ASSR south of the Kama River and along the right bank of the Volga, as well as in the northern forest-steppes of the Bashkir Republic which adjoins from the east.

In terms of the overall direction of agricultural development, the entire zone should stress primarily potato growing and hog raising, together with the production of grey cereal grains, with a more intense development of hog raising in subzone "a", with less stress in subzone "b", where dairy farming should be more developed.

Of leading importance among the technical crops of this zone should be potatoes (mainly for plant processing but for fodder purposes as well), which find here sufficiently favorable conditions for good yields. Sunflower and corn (with the exception of their cultivation for ensilage) can not be grown on account of the lack of warmth and shortness of the growing period.

Of the grains, leading importance goes to grey cereal grains. Among winter crops, rye is the crop, since due to severe winters, a noticeable forward movement of winter wheat can not be counted on in the immediate years to come, that is, in view of the fact that there is a lack of winter resistant varieties. With sufficient precipitation in this zone, oats still produce rather high yields of grain which, moreover, is of export quality. Due to the extremely

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widespread prevalence of the Swedish fly, barley can not be grown here and spring wheat can be moved only into subzone "b". In the entire zone, as secondary crops, great attention should be paid to the expansion of lentil and pea plantings.

Of essential importance in subzone "a", together with rye, oats and potatoes, there should be hemp, which, due to good soils and sufficient precipitation, finds favorable conditions for good yields, and in the western section of the zone, for good fiber quality as well. Among the fodder crops, there are clover with timothy, the vetch-oats combination and ensilage crops. There should be an extensive development of clover sowings for hay and as artificial pasture for hogs. Into subzone "b", which is slightly less arid and suffers less from the Swedish fly, spring wheat and the earliest ripening sunflower varieties can be moved in from the south. Hemp can not be of any real importance. In connection with the necessity and possibilities of dairy farming, fodder crops have to be extensively expanded (vetch-oats combination and particularly sowings for ensilage).

Spring Wheat Zone

11. The enormous spring wheat farming zone stretches in a belt from the Ukraine and the North Caucasus to East Siberia, including the semiarid forest-steppes and arid steppes of the European southeast as well as comparable districts of the Trans-Urals, Siberia and Kazakhstan. The last mentioned areas are comparable to the southeast, in terms of the amount of precipitation, soils and natural vegetation. They differ from it, however, in the severity of the winter, in the less hot summer, the shorter growing period, and accordingly in the somewhat different combination of crops additional to wheat.

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According to that, and the difference in soil-climatic conditions, particularly the degree of aridness in moving from the north to south and southeast, the spring wheat zone has to be subdivided into the following subzones:

(a) Spring wheat, oats-rye, clover-potatoes located in the northern forest-steppe in the former Kungursk Okrug and Mesyagutovskiy Canton among the forests of the Predural'ye. Sufficient precipitation and more or less favorable soils (lixivated and degraded black earths) cause high and reliable yields of spring wheat, therefore, this subzone should become an area for more intensive cultivation. But, together with spring wheat, it is necessary to develop also dairy farming and production of other supplies which are difficult to transport but are needed for local consumption by the population in the nearby industrial and metallurgical centers of the Urals. The above-mentioned soil-climatic conditions are quite favorable for the development of fodder crops (particularly clover) also for seeds, root tubers, ensilage plants and potatoes for food as well as for fodder. Oats should be kept for industrial needs and rye for the purpose of supporting fields planted with winter crops (prolongation of the planting and harvesting campaigns).

(b) The spring wheat-oats subzone with grass sowing is analogous to the preceding one in soil and climatic conditions, but located in the northern flood land meadows and foothill forest-steppes of the Trans-Urals, West Siberia as well as over the lixiviated and degraded black earths with more or less sufficient humidity which, however, can not be counted upon.

Together with good and rather steady yields of spring wheat (which areas are being greatly expanded) the conditions of nature

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favor dairying (and in suburban metallurgical districts of the subzone, near the Urals and Kuzbass, this includes fresh milk). In addition to natural meadows and pastures, it is necessary to develop fodder crops as much as possible, among these particularly a mixture of American couch grass and winter-resistant types of alfalfa (in the northern and foothill sections, also clover), sweet clover for pastures and sunflower for ensilage. Oats cultivation should be continued. Among the additional crops, subject to particular development, there is flax for fiber in the humid northern and foothill sections of the subzone, and sunflower and hemp in the southern part of the Altay foothill forest-steppes.

(c) The spring wheat, sunflower, rye-oats subzone is on the fertile black earths of the European forest-steppes in the former Buguruslan, northern part of the Samara Okrug and the adjoining part of the Bashkir ASSR. The slightly more arid character than that of the preceding zones is less favorable for the growth of fodder crops, but the longer growing period permits the cultivation of sunflower (most early ripening varieties). So far, it does not cover a large enough area, but particular attention should be paid to its forward movement, as well as to the further expansion of spring wheat plantings. Areas under rye (due to the impossibility, so far, of winter wheat cultivation) and oats (with good yields and good grain quality) should be continued. Grasses, root tubers and ensilage plants should have their place among additional crops.

(d) Spring wheat, grass, with sunflower in the southern section. This subzone occupies the southern forest-steppes of Trans-Urals, West Siberia and Kazakhstan, on fertile and regular black earths, with semi-arid climate; similar to the preceding subzone of the European part,

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both according to natural conditions and to on the average good but not quite steady spring wheat yields of good quality grain. This is a subzone of extensive specialization in spring wheat (eastward movement of wheat). Besides that, in the northern section, there still are favorable conditions for the successful cultivation of oats and fodder, which are indicated for the northern forest-steppes. Grasses (butter-dairy farming) still have to be sown throughout the entire subzone because of the need to restore the structure and fertility of the soils. The southern part of the subzone is an area of intensive forward movement of sunflower (early ripening varieties). It is planned to gradually remove this crop from this zone of adequate moisture in the North Caucasus, where good yields are possible with soils new to the area without broom rape. Finally, it would be in the interest of keeping the wheat crop rotations free from weeds (since it is the only possible row crop, in view of the insufficiently long growing period and lack of the necessary warmth for corn).

(e) Spring wheat, sunflower, corn subzone with a semiarid and arid climate, on regular and southern black earths of the Central Volga region (and in the Zilairskiy Canton of the Bashkir ASSR), the Lower Volga Kray, the former Donets ~~ASSR~~ and the Shakhtinsk ~~ASSR~~ Okrugs of the North Caucasus. Typical grain farming, with unsteady yields (due to frequent droughts) of spring wheat, but with grain of very good quality. Further intensive development of sunflower cultivation is necessary. A possible expansion of corn plantings is particularly needed in order to develop animal husbandry for meat, and as a hedge against wheat yields; as well as for cleaning the fields of weed grasses. Plantings of more drought-resistant grasses (hybrid and yellow alfalfa, brome grass, couch grass, Sudan grass) should be increased,

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particularly perennials, not only as fodder for the meat cattle industry, but also in order to maintain soil fertility. Barley growing is permissible (as a crop which suffers less than oats from drought and heat seizures during the ripening period) and winter rye (until the time, when it will be possible to move forward the particularly winter resistant varieties of winter wheat).

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(f) Subzone of spring wheat, sunflower and oil flax, located on the arid southern chernozem steppe of the Trans-Ural region (the former Troitsa Okrug), Western Siberia and Kazakhstan. It resembles the preceding subzone located in the European part in aridity, continental climate, and its rather low and undependable yield of spring wheat, though of excellent quality. The presence of large areas of virgin soil and uncultivated land makes possible the advance and very large scale expansion of the spring wheat area, but only on the necessary condition that only "dry farming" methods and systematic crop rotation be used. For the same considerations that apply to the analogous zone of the European part of the USSR, extension of the following crops is projected: sunflower (except on solonetz soils), oil flax, cucurbits, and the same grasses. ^{Proso} ~~Exotari~~ millet is the most drought-resistant grain, and can survive here. It is cultivated as a standby crop. Winter rye is killed by frost, and does not thrive here.

(g) Subzone of spring wheat, proso millet and cucurbits found on chestnut earths. It has a very arid climate, and is situated in the border region of the former Kamyshin Okrug, in the northern parts of the former Pugachev Okrug, Trans-Volga, in the Volga German ASSR, in the northwestern part of the former Stalingrad Okrug, and also in the northeastern arid part of the northern Caucasus, and in Kazakhstan. It is a spring wheat region, with low and very unreliable yields of excellent quality. The remarks on the application of dry farming methods and forage grasses in the preceding subzone apply here also to the greatest possible degree. In view of the instability of crop yield, it is imperative to develop beef cattle farming and to find more

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drought-resistant forage crops, which so far include zhitnyak (*Triticum cristatum*), Sudan grass, sorghum and proso millet. The last named is essential as a stand-by crop. Wide development of cucurbit culture and of mustard and saffron growing is possible. Winter rye can survive. Sunflower and corn do poorly on account of the excessive aridity of the climate, and to some extent on account of the salinity of the soils.

(h) Subzone of spring wheat, oats, spring rye, and pasture, occupying an extremely large area of the open taiga, wooded steppe, and in places, on the steppe of the trans-Baykdl and Amur regions. The climate is typified by exceptionally continental character, the dryness and great heat of the short summer, and the bitterness and lack of snow during the winter. The soil cover is not uniform, being broken up by the relief features of the zone. In general, the primary crops in the separate sections of this subzone are: spring wheat, oats and spring rye, with varying proportions of winter rye, buckwheat, barley, millet and potatoes. The existence of various types of pasture and meadow land of spring-flood, mountainous, steppe or taiga areas, is of great significance for the development of animal husbandry.

In many places with poly-metallic ore deposits, vegetable farming should be organized.

Transformation of land through reclamation into plowlands, the organized development of irrigation in the south, and the selection of plant strains to meet the specific conditions of the zone, should act as a powerful stimulus to the productivity of grain farming of this zone, which is extremely important to the economic life of our eastern regions, and should help to strengthen the cultivation of spring wheat, which is a more valuable crop than spring rye or oats.

(i) The spring wheat, oats, soybean subzone embraces the

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Amur and Zeya-Bureya meadow steppes, and is the granary of the Amur and Maritime regions. The humid monsoon climate with its hot and very rainy summers favors abundant harvests of spring wheat and oats, though the cold snowless winters restrict the cultivation of winter grains. Moreover, the length of the growing season in the south aids the ripening of the earliest-ripening varieties of soybeans. Increasing the sowing of grains in the future would be dependant upon the selection of strains which are resistant to fungus diseases, while increase in soybean growing hinges on quick development, on a large scale, of fast maturing sorts.

In the interest of the development of livestock and dairy farming, it is necessary to increase the expansion of growing of forage grains, and to utilize the rich natural meadowlands more effectively.

The shortness of the harvesting season and the high humidity during this period emphasize the need for mechanizing the harvesting of meadows and sown crops, and for organizing the drying of the crop, just as the intense chilling of the ground in winter, the dryness of the spring, the development of swampy conditions during the very rainy summer and autumn, and the existence of an environment favorable to the growth of fungus diseases, demand special attention of agricultural technology, and the selection of seed, crops and varieties.

12. The zone of oasis agriculture (in semi-desert areas) on complex saline-chestnut soils, with saline components predominant: in the southern part of the trans-Volga cantons of the Volga German ASSR and the former Pugachev Okrug, in the Trans-Volga por-

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tions of the former Stalingrad Okrug and the former Astrakhan' Okrug, and in the immense territory of the grassy semi-desert steppes of Kazakhstan.

The extremely arid climate permits cultivation without irrigation only under exceptional circumstances, on the more humid soils (including those in the depressions). In these cases only the more drought-resistant varieties of wheat, cultivated ^{proso} ~~forage~~ millet, cucurbits, flax, mustard and saffron may be sown. It is necessary to build irrigation works and to solve the problem of introduction of the more drought-resistant forage plants for livestock farming.

13. The zone of sugar-beet economy is located on lands with a good supply of moisture, and embraces the wooded steppes of the rich, degraded chernozems of Tsentral'no Chernozemnaya Oblast and of Right-Bank and Left-Bank regions of the Ukraine. It should be divided into two subzones.

(a) The transitional zone of sugar beet, winter wheat, rye, oats, and potatoes occupying the wooded steppes of Tsentral'no-Chernozemnaya Oblast, with rich and leached chernozems. This subzone represents a transition from the rye, oat, potato zone adjacent to the north. Sugar beet productivity is high. Its winters, which are not too severe, make possible (especially in the south) considerable increase in the growing of winter wheat, which already exists in this subzone, and thereby replacing rye, which has managed to survive in the north and on the poorer soils. Of the spring cereals, oats may be sown, the wheat and barley crops suffer from the Swedish fly. Among the supplementary crops, growing of peas, lentils, kidney-beans and vetches should be increased,

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while the cultivation of potatoes for industrial purposes should be continued in the northern part of the subzone. There is room for expansion of fodder cultivation to facilitate development of animal husbandry based on the wastes from the sugar beet industry.

(b) The sugar beet and winter wheat subzone is located in an area of rather mild conditions, with a good moist climate, on the wooded steppes of Left-Bank and Right-Bank regions of the Ukraine. Its soils consist of degraded, leached chernozems.

The sugar beet and winter wheat, which give a consistently high yield in this subzone, sound the keynote for the specialization of agricultural economy. Corn and forage crops, including early red clover, vetch-oats, blue alfalfa, root crops and silage crops, are also of great importance for the expansion of the animal husbandry feeding on by-products from beet sugar mills. Soybeans, lentils, and kidney beans are also very important, in this connection. Makhorka tobacco produced in the Priluki-Konotop region should also be noted. Growing of potatoes, winter rye and oats should be curtailed, and can be left primarily to areas with poorer soils, consisting of sandy loams and sands.

In the regions with a suburban economy (Kharkov, Kiev), the beet sugar zone should shift its economic orientation to emphasize the development of vegetable and fruit-berry crops, as well as the cultivation of potatoes for human consumption and of fodder crops for dairy farming.

The vast area of the northern and eastern semi-arid chernozem steppes of the Ukraine and the adjacent sections of the Tsentral'no Chernozemnaya Oblast (the former Rossoshan and Ostorog Okrugs) and the North Caucasus (the former Don Okrug and the southwestern part of Sal'sk Okrug) includes:

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14. A transitional spring and winter wheat, corn, sunflower and barley zone. At the present time, sowings predominantly consist of spring wheat and barley, but it is desirable, from the point of view of the national economy as a whole, to develop a specialization in hog-breeding and poultry farming, together with grain production. This will demand a radical revision of current agricultural practices in the zone, which natural conditions would allow.

The recent frequent losses of winter wheat occasioned by severe winters with light snowfall (especially in the eastern part of the zone) could be considerably curtailed by the mass distribution of winter-hardy varieties (Gostianum 237) that is now possible, together with early sowings and the use of proper methods of agricultural technology. In this connection, winter wheat could gradually take the leading place among the grains (as the number of winter-hardy varieties increases), with spring wheat remaining as a stand-by crop, especially in the eastern part of the zone, and especially hard wheat, which gives a better yield here.

Even though corn gives only mediocre yields in comparison with other more humid regions, its cultivation should nevertheless be extended where possible so as to further the interests of animal husbandry and poultry farming and to increase the yield of grain crops. Sunflower, which now occupies a very considerable area, is the leading cultivated crop next to corn. Its sowing could be stabilized, and further extension of broomrape infestation avoided; the present area under barley forage cultivation should be maintained, in view of present high crop yields, its large-scale commercial value, and its use to supple-

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ment corn for livestock fattening. Cultivation of forage crops and cucurbits should be expanded. The indicated sharp increases in sowings of winter wheat, corn and fodder crops may be carried out partly by way of more efficient organization of crop rotation and partly by elimination of oats and rye (except on sandy soils).

The Dneprostroy region, with its great manufacturing centers and potential irrigation, and the metallurgical region of the Don Basin, both of which are situated in this zone, should give to agriculture a character sharply differing from that of the rest of the zone. Along with fruit-growing, the cultivation of vegetables, forage grasses, tubers, silage and new potatoes assumes the position of primary importance, with cereal culture relegated to a secondary place.

15. The zone of glossy winter wheat, of the new cotton regions AND the southern industrial crops, is located in two separate sections: in the arid southern steppes of the Ukraine, Crimea and Taman' Peninsula, and in the Kuma region of North Caucasus, with very similar soil and climatic conditions. Emphatically reflecting the arid character of this zone, the long frost-free period and the hot summer favor the cultivation of the early varieties of cotton, castor bean, sesame and other industrial crops. The relatively warm winters, though not infrequently snowless, favor the cultivation of winter wheat. This crop, owing to the hot arid summer and the chestnut soil, is of first-class quality, both in gloss and in other characteristics. To supplement these principal crops, namely winter wheat, cotton

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(incertain definite areas only) and the industrial crops, barley (including winter barley in the Crimea and the Kuma region) is grown and gives a good yield here. Its cultivation should be continued. This region is unfavorable for sunflower, corn and soybeans, because of scant reinfall during July and August and of the frequent losses during the blooming and ripening periods. In spite of this, however, the extensive cultivation of corn in this zone is desirable to provide a stand-by crop for spring cereals as well as the best predecessor, together with cucurbits for cereals. The following crops are of secondary importance, but should still be expanded by all possible measures: cucurbits, castor beans, sesame, saffron and oil flax; grain sorghum and chick peas. Among the forage crops the most drought-resistant should be selected, namely, yellow alfalfa, zhitnyak, Sudan grass and sorghum; corn, silage sorghum; fodder squash and watermelons.

16. The zone of winter wheat and corn growing, with its sub-zones, one of which is located in the Ukraine on the right bank of the Dnepr River, and the other in the North Caucasus.

The winter wheat, sugar beet, soybean subzone occupies the southwest portion of the wooded steppe right bank part of the Ukraine nearest the frontier. Its mild and rather humid climate favors high and reliable crops of winter wheat and good yields of corn. The areas under winter wheat should be maintained as a reserve source of wheat production for the entire USSR, but sowings of corn should be expanded as much as possible, with simultaneous development of hogbreeding and poultry farming. This is the best region in the Ukraine for soybean cultivation. Although there are a considerable number of beet sugar mills, the

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yield of sugar beet crops here is much lower than in the main sugar beet zone (probably in consequence of the fact that the soils, consisting of forest and degraded chernozems, are somewhat poorer). For this reason, as well as on account of general considerations, the sugar beet should here be relegated to a position subordinate to that of the above-mentioned crops.

Abundant precipitation favors the cultivation of forage plants, which should be considerably expanded, because, among other things, there is no harvest of natural hay. Alfalfa and vetch mixtures are recommended, together with early red clover in the northern section. In addition, rye, winter vetches and soybeans should be grown for green fodder, while corn, horse beans, Jerusalem artichokes and soybeans should be used for silage. Root crops for fodder comprise the mangel-wurzu and the carrot.

Malt barley is a supplementary crop whose cultivation is subject to expansion. Potatoes occupy a similar position in the northern section of the subzone, where corn does poorly. Among the secondary crops, expansion of areas sown to mustard, lentils, kidney beans and especially spring and winter seed vetches, should be encouraged.

The cultivation of rye should be sharply restricted, while that of oats should also be curtailed.

The winter wheat, corn and sunflower subzone (in which soybeans and castor beans are also major crops) is similar to the preceding subzone in the mildness of its climate and the abundance of its rainfall. It occupies the region of so-called unstable humidity in North Caucasus, on the chernozem belt

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along the border of Asia. A high yield of winter wheat is likewise assured by the mild winters, while good corn crops result from the sufficient precipitation and the length of the growing season, which is even longer than in the preceding subzone.

In this region of hogbreeding and poultry farming, since acreage in winter wheat unquestionably must be maintained and corn sowings greatly expanded during the next period of the Five-Year Plan, sowings of sunflowers should remain at a suitable level, until the cultivation of this plant is widely disseminated through the east.

The following crops should occupy a supplementary position: Industrial crops: castor bean, soybean, Bombay hemp, abutilon (Chinese jute) and sugar beets; Grains: forage barley and kidney beans as grain crops.

The cultivation of spring wheat could be considerably curtailed, but in the eastern section of this subzone, it could be left at present levels, with a predominance of hard wheat. In general, oats and rye could also be eliminated from the planned sowings.

It is essential to encourage in every way the cultivation of forage crops, such as alfalfa, Sudan grass, sugar sorghum, semi-sugar beets, and forage cucurbits, together with corn, sorghum and soybeans for silage.

The subzone of winter wheat, corn, soybeans and southern industrial crops stretches further to the south. Owing to the proximity of the Caucasus mountains, humidity is even higher than that in the rest of the zone. It occupies a belt of chernozem

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steppe along the northern slope of the mountains, and offers exceptional advantages by reason of its mild climate, its high precipitation, its warmth and the length of its growing season. The abundance of crops made possible by natural conditions requires special emphasis to be placed on the especially desirable and valuable crops (the southern industrial technical crops), and on those grains (wheat) which give invariably high and reliable yields in this region, as an insurance for the Soviet Union as a whole against the consequences of unfavorable cyclical conditions, droughts and severe winters in other regions of the country, or, in the case of corn, to provide the basis for the development of dairy farming, hogbreeding and industrial utilization of corn.

Accordingly the leading crops to be cultivated in this subzone are corn, winter wheat and soybeans. The best region for the latter in the entire European part of the Soviet Union is in the foothill areas of this zone. Of the other industrial crops, such as castor beans, Bombay hemp, Kendyr, peanuts, sugar beets and, to a lesser extent, abutilon (Chinese jute), may be cultivated as supplementary crops on smaller areas, but still with a marked expansion from present levels. The large area now growing sunflower could be reduced, though the existence of processing mills would require such reduction to be gradual. In this way acreage could be released for the above-mentioned crops. The sunflower cultivated acreage here over a wide area could be reduced (gradually because of the pressure of processing plants) to relieve the area of contamination by broom rape. The areas sown to barley and especially to spring wheat could

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also be reduced.

Cultivation of the same fodder crops noted in the discussion of the preceding subzone should be sharply expanded, because of identical considerations.

The subzone of winter wheat, corn and tobacco cultivation is situated in the wooded highland belt of North Caucasus, and also enjoys adequate moisture and a mild climate. However, the summers are shorter and not so hot, which makes it impossible to increase the cultivation of a number of industrial crops. The western portion of this subzone is one of the principal tobacco growing regions, the cultivation of which it might be possible to expand further. Because of its relatively small over-all acreage available for cultivation, the subzone is overloaded by a disproportionate and extremely large percentage of corn sowings. The production of corn should be further expanded by improving soil productivity through the use of better methods of agricultural technology, but without any increase in its acreage. This should be accompanied by increased cultivation of tobacco and winter wheat, and of potatoes and oats as supplementary crops. These grow well here and are required for the needs of the local health resorts, while oats are also used for draft horses in the mountains. The sowing of clover and silage crops is necessary to supplement natural pastures and hay harvests, as well as the use of potatoes for the same purposes, to aid in the development of dairy farming and cheese production in the mountains.

17. The zone of the southern industrial crops is located along the frontier of the RSFSR and occupies the shore of the Black Sea

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from Tuapse to Abkhazia, as well as the southern shore of the Crimea. It has an abundance of warmth and moisture, and a long growing season. Owing to the importance of its horticulture and of its valuable subtropical crops, there is no acreage available for the ordinary field crops.

18. The zone of soybeans and rice, wheat, and industrial crops represents an exception to the above-mentioned zones. This zone occupies the lowlands along the Amur and Ussuri rivers. Cultivation of a typical combination of Far Eastern crops is permitted by the rich alluvial soil and by the hot, humid, monsoon climate. However, the sections of this zone differ among themselves in this respect by reason of the varying length of the growing season. While rice, soybeans and a whole series of supplementary and secondary crops may be successfully cultivated in the Suifen-Ussuri region, the possibility of cultivating the later-maturing varieties of these is sharply limited in Khabarovskiy Rayon. The use here of early-maturing varieties of rice, and especially of soybeans, hemp and similar plants, opens up broad perspectives. The existence of rich marshy and lowland meadows also affords great possibilities for the development of animal husbandry.

The swampy character of the soils in this region makes it essential to proceed with intensive draining operations.

The agriculture of this zone includes a large number of crops which demand considerable labor, while the harvest season - simultaneous for field crops and hay - is exceedingly wet. These factors demand the broad mechanization of field operations and also require the organization of crop drying. The possibility of exploiting a climate favorable for many valuable crops

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also demands the extensive undertaking of meliorative and irrigation projects, the improvement of the soil background by the application of chemical fertilizers, and the proper employment of agricultural technology and of methods of selecting plant varieties adapted to the specific characteristics of the monsoon climate.

THE ZONES OF COTTON AND OTHER INDUSTRIAL AND
RELATED CROPS IN THE CENTRAL ASIATIC REPUBLICS,
SOUTHERN KAZAK^HSTAN AND KIRGIZIA.

The zone of unirrigated grain cultivation and fruit growing found along the foothills and the lower portions of the slopes of all the mountain range systems of Central Asia. Irrigation is possible in some of the valleys. This zone is divided into two parts:

(a) The foothills of the Central Tian Shan and Dzhungarian Alatau. It is possible to cultivate the opium poppy, sunflower, corn, sugar beet and potato in rotation with grains.

(b) The foothills of the western Tian Shan, Pamiro-Alay and Dzhungarian Alatau. It is possible to cultivate corn, winter peas, oil flax, saffron, sesame, and, in some places, early-maturing and medium-early-maturing varieties of cotton, in rotation with grains.

The zone of irrigated agriculture along the northern foothills of the Tian Shan and around the Dzhungarian Alatau.
Unirrigated agriculture is impossible. This zone is divided into two parts;

(a) The northern section, north of the Ili river. This

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section produces cereals and the southern industrial crops: Bombay hemp, sugar beets, opium poppies, etc.

(b) The southern section, from Dzharkent to the crest of the Karatau. This section produces cereals, the southern industrial crops, and alfalfa. On a small experimental scale it has also produced early-maturing varieties of cotton.

The zone of rice, cereals and the new bast fiber plants is located on the lowlands along the river and lake shores of South Kazakhstan.

The zone of cotton cultivation in the hot deserts and the torrid deserts of the central section of Central Asia. This zone is divided into three sections:

(a) The downstream areas of the Amu-Dar'ya river, which produce early-maturing and medium late-maturing varieties of cotton, seed alfalfa, and, in places, cereals.

(b) The valley of the Syr-Dar'ya River, Fergana and Central Zeravshan, which produce medium early-maturing and medium late-maturing varieties of cotton.

(c) Southwest Uzbekistan and South Turkmenia, which produce the medium late-maturing varieties of cotton, principally Egyptian varieties.

The zone producing the long-fibered Lower Egyptian varieties of cotton, together with other subtropical crops, is located in South Tadzhikistan and Southwest Turkmenia.

THE NON-CHERNOZEM BELT

V.P. Kuzmin

Boundaries. The term "non-chernozem belt," in contrast to the rich humus soils of the south, is applied to the territories

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situated on the swampy, leached soils in the north of the Soviet Union. It consists of zones of tundra, wooded tundra, marshy evergreen forest, dry-valley taiga, mixed and deciduous forest. In places it includes occasional tongues and islands of wooded steppe and steppe, usually linked with azonal chernozem islands of different physiognomy. A more general characteristic of this territory is the short period of warm weather, for only in the extreme east and west is the frost-free period longer than 130 days.

There are three general characteristics of the line drawn approximately along the divide between the Pripet and Bug Rivers, the lower reaches of the Desna River, the course of the Oka River and of the Volga as far as the confluence of the Kama, the courses of the Kama and Bela Rivers, thence along the line drawn through the cities of Irbit, Barabinsk, Novosibirsk and Ulala, thence eastward to the point of intersection of the Tannu-Tuvan, Mongolian and Chinese frontiers. This line in general marks the southern boundary of podzolic soils, the southern boundary of the forests, and the northern boundary of the area with a long growing season, and it thus represents a sharp and clear-cut barrier to the northward advance of a large number of cultivated plants. By the same token, it limits the selection of varieties for introduction in the north to a relatively restricted group of various forms.

Characteristic also of this northern territory is the low total temperature of the growing season (under 2200 degrees). In the larger portion of the territory there is an excess, or at any rate a very considerable amount, of summer rainfall, in comparison to the evaporation, and similarly, except in the east,

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there is heavy winter precipitation.

The Basic Regions

With regard to the latter characteristics, however, the territory of the north is sharply divided into three basic regions: a cold subpolar region, with a very short summer, a temperate western region, with great humidity and much snow, and a less humid eastern region, arid in many places, with little snowfall, severe winters and an emphatically continental climate. The meadow-steppe regions of monsoon climate in the basin of the Amur River are separately distinguished, apart from the above major division, (cf. Map 1).

The approximate southern boundary of the subpolar region is formed by the southern boundary of the northern marshy evergreen forests and of the northern taiga, and the region thus includes the Murmansk area together with the northern parts of Karelia, the Severnyy Kray, Ural'skaya Oblast, the Vostochno-Sibir' Kray, Yakutia, and the Pacific territory.

A line dividing the swampy taiga of the western Siberian lowlands from the dry bottomland taiga of Central Siberia may be taken as the boundary between the western and eastern regions; the approximate course of this line is along the Yenisey River (on the Yenisey Ridge, and more precisely, in the south, along the Kan and Chulym Rivers). (This line also coincides with the western limit of permanently frozen soil. Cf. M. Smolgin, Permanently Frozen Soil, Vladivostok, 1927.)

Sharp transitions in the climate and soils of the north are marked by these boundaries. In the northern region the growing season is invariably short (under 100 days), there is little

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heat and much light in the summer, an extraordinary degree of swampiness together with poor soil development and permanently frozen soil. In the western region, the growing season is longer (up to 140 - 150 days); precipitation is abundant; heat is uniformly distributed and sufficient for intensive agriculture; and there are marshlands and strongly podzolic soils. Finally, in the eastern region, precipitation is moderate - insufficient in the Minusinsk basin and southern trans-Baykal - insolation is intense; the growing season is short (100 - 110 days); the winters are snowless and exceptionally cold; and the soils are mainly bottomland, weakly podzolic in character and richer in humus, with occasional occurrence of perpetually frozen subsoil.

(In a preceding section of this work, a more detailed division of the north into zones and subzones will be found. There, too, a further subdivision into regions has been undertaken. These regions sometimes coincide with political subdivisions. These and the others have been divided according to the more general characteristics relevant to cultivation of field crops. For lack of space, we have here omitted a regional division of the northern territory according to the requirements and the significance of the separate field crops. These details are noted under the further subdivisions of the aforementioned regions.)

The General Character of Agriculture

These peculiarities of climate and soil are reflected with extraordinary emphasis in the general character of agriculture in the north as a whole, as well as in its separate parts; and sharply distinguish its agriculture from that of the more

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southerly regions of the Soviet Union. The great humidity of the air, the enormous amount of atmospheric and soil moisture, and the general prevalence of cloudy conditions, in conjunction with a uniform distribution of heat on poor soils, afford the optimal conditions for the cultivation of plants such as flax, hemp, grass, potatoes, tubers, etc., of which the useable portions are primarily the vegetative rather than the reproductive organs. In the specialization of northern agriculture, it is this which is the most characteristic peculiarity of the natural conditions, and it is this above all which should be taken into account. However, where the soil is adequately fertilized and properly cultivated, early-maturing varieties are selected and the crops are properly protected from damage by frost or autumnal bad weather, the abundant precipitation of the north assures an extremely high degree of fertility, which is stable from year to year, and is far higher than that attained on the chernozems of the arid south. It is under these conditions that the yields of grain crops have been increased, both abroad and in the Soviet Union.

The Subpolar North

The severe conditions in the subpolar north have operated until now to check its settlement, and are vividly reflected in the development of its agriculture. Up to the present time, agriculture in this region has had neither extensive practical experience nor an adequate amount of experimental data. All the agriculture here is oriented towards the utilization of natural resources: reindeer pastures, river bottom land, berry patches, etc. The industrial development of a large number of places with extremely rich mineral deposits, and the exploitation of

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the forest, fishery, fur and other wealth of the subpolar north, which was formerly considered a reserve for the most distant future, is now stimulating a very considerable industrial settlement of the Far North, separated as it is by immense distances, difficult to traverse, from the agricultural south. It is the primary task of the agriculture of this region to supply industrial centers with products which are difficult to move and stand transportation badly, for it is particularly difficult here to solve the problem of overcoming distances.

It is, however, in this very region that we encounter the largest number of factors tending to limit the development of agriculture. Of these factors, the following are basic and should be taken into consideration before all others: small amount of heat, short summers with unseasonable frosts, severe winters, marked by but little snowfall, exceptional extent of marshlands, perpetually frozen subsoil, and the extremely great proportion of forested area. In these vast expanses, the positive factors are: the great length of daylight during the summer, and in the eastern part, a region of maximum insolation, which latter regulates the supply of moisture from the perpetually frozen subsoil. There are broad valleys of rivers with immense watersheds and mild steady currents which deposit fertile soil, and abundant flood meadows. There are also lowland marshes which can be converted into agricultural land with relative ease. Since ancient days, these two types of land have been one of the main sources of forage, and have constituted a regional resource of colossal wealth. In places whose contours

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afford a greater measure of shelter from frost, cold winds and fog, and supplied with natural sources of surface water and ground water - principally on or near the terraces of river valleys - it is possible to cultivate barley and, to a lesser degree, winter rye and the earlier varieties of spring wheat and oats. The cultivation of the perennial grasses, especially in the east, is rendered very difficult by the severity of the winters and the nature of the soil. The annual forage crops, potatoes, and turnips are very important in the agriculture of the region, especially along its southern boundary.

In the north, even vegetable gardening is possible only in hothouses or in sheltered locations. Of particular current interest in this connection are the problems relating to shortening the growing time by acting on the plant organism, and the duration of its stay in the ground, problems of agricultural technology, mechanized meadow cultivation, technical equipment of vegetable growing, employment of heat and light in it, through the use of independent heating plants and electric installations, and, incidentally, the establishment of industrial centers. The selection of varieties and seeds of perennial grasses for the rotation of meadow and field crops is also especially important.

Meadow cultivation, vegetable growing, and the effective organization of the natural forage areas make up the basic character of agriculture in the Far North.

The Continental East

In the very short duration of the frostless period, and in the exceptional severity of its winters, the climate of the eastern region resembles that of the Far North, except that sum-

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THE BASIC AGRICULTURAL REGIONS OF THE SOVIET NORTH

USSR

Kilometers

LEGEND

----- Present northern limits of agriculture. This line connects the outermost outposts of agriculture in the Soviet Union.

..... Boundaries of the zones of agricultural cultivation

The Subpolar North

The Continental East

The Humid West

The Region of Eastern Monsoons

Produced in the Bureau of Cartography of the VIR under the supervision of A. G. Grimm-Grzhimaylo.

Drawn by E. F. Michurin,
Cartographer.

Compiled by V. P. Kuz'min

MAP I

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mers are hot, while its soils are less marshy, weakly podzolic and fertile. The climate is less humid and more continental in character and is thus less favorable to the cultivation of the forage plants, sharply limiting their diversification. The long, cold winters, with light snowfall, are very important in this respect, as they limit the areas suitable for perennial grasses and winter rye. The early spring crops - hemp, flax, wheat, oats, rye and barley - thanks to the intense insolation - successfully complete their growth cycles and give very high yields. However, along the northern boundary, it is necessary to transplant the seedlings in years of crop damage by early frost. The immense distances on the taiga, the occasional sharp irregularity of the relief, and the exceedingly low population density, all make for an abundance of natural pasturage, which can sometimes be used even in winter. The marked fertility of the soils makes agriculture less dependent on the use of fertilizers (except for nitrogenous types) than in the north and west, and in the presence of an adequate supply of wood for fuel is assured, a large reserve of manure is accumulated, which can be successfully utilized even in the cultivation of the more demanding crops, such as hemp.

However, the wide possibilities for the development of an animal husbandry based on the natural forages demands a more balanced feeding pattern. Especially during the winter months, larger proportions of dried, succulent and concentrated feeds should be used. A whole range of problems in this field still remains almost untouched. It includes the organization of forage supply and of the utilization of the natural forage areas,

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the immediate development, on a broad front, of the work of selecting perennial grasses adapted to local winter conditions, the employment of both local and world-wide sources for obtaining such varieties, and also, the intensification of selection work for industrial crops, such as flax, hemp, badan (*Bergenia Cressifolia* - Mongolian tea), mustard and gold-of-pleasure, together with root vegetables and grains, with the object of securing early-maturing varieties which are hardy against the numerous local conditions and enemies; and, finally, the study of the methods for cultivating these plants under the most varied and unusual conditions (irrigation, perpetually frozen subsoil, intense cooling of the soil in winter, intense heat in the summer, etc.).

The major obstacle to the exploitation of the local natural resources is the shortage of labor; but this will be overcome in the near future by harnessing the energy of the Angara, Yenisey, Irkut, and Chulym rivers, and others. This will impart a colossal stimulus to the development of agriculture, to its successful advance onto the wild taiga, and to the introduction of more intensive cultivation of industrial, cultivated, vegetable, and forage crops.

The Humid West

Finally, the western part of the non-chernozem belt offers an entirely different picture. This is the oldest agricultural region of the north, and is at the same time the region of maximum future intensification of agriculture. It enjoys a considerable amount of uniformly distributed heat, abundant precipitation in summer and winter, and high atmospheric

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humidity. These conditions not only assure, for a great number of crops, the highest and most stable yield in the Soviet Union, but also guarantee the highest quality for some of them (fiber, flax, malt barley, potatoes, etc.). Forage and industrial crops are not the only ones to enjoy conditions that guarantee a maximum yield. The grains, too, give exceptionally high yields in this region, particularly in combination with pasture crops and clover.

A number of regions with unusual soil conditions encourage and find very profitable the cultivation of a number of valuable crops. Immense areas of mellow sandy soil favor the potato. The drained marshlands, rich in nitrogen, guarantee maximum productivity of forage crops and constitute a valuable reserve for the expansion of acreage under hemp, while the humus-carbonate loams and the grey forest soils are excellent for the better varieties of barley, wheat, etc.

Organic and mineral fertilizers are here most effective on poor and acid soils.

It is here that we can attain the levels of productivity displayed by the Baltic countries, if we develop mechanization and the use of chemical fertilizers. Conditions in our humid Western region are nearest to those in the Baltic countries, and it is here that it is easiest of all to surpass their example. Sufficient experimental material to prove this is already available. And this is the region which offers the greatest assurances for agricultural stability, so that only through the bungling of the past could it have become an unproductive consuming area!

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The provision of energy for agriculture is increasing. It is based on the network of Machine Tractor Stations, on the expanding construction of hydroelectric plants on the Volga, the Svir' and other rivers, on the existence of the Volkhov, Osinov, Shatura, Kashira, Bobrikov, Bereznikov and a long series of other regional power stations burning locally produced peat and coal, and on the existence of the mighty power installations of Ural-Kuzbas, etc. All this represents a mighty basis in power production, both for the transformation of the entire agricultural background of this zone and for the processing of the volume of production which can be achieved here. Above all, the mechanization of and power supply for reclamation operations, especially soil drainage, must exert a great influence on the level of the cultivated condition of the fields, which is an essential prerequisite for the expansion of acreage under the more valuable and exacting crops and varieties. It is also a condition for their introduction into new regions.

It is precisely in this region that the planned realization of the organization of production and the planned supply of seed open up broad possibilities for a more purposeful and efficient geographical relocation of the old crops, accompanied by consolidation of the position of the less popular varieties, and the introduction of new crops. The following may serve as instances: the intensive northward expansion of the flax-growing areas in the basins of the Sukhona and Vichегда and further north, where this crop yields the best fiber but does not always ripen well into seed for linseed oil, as well as beyond the Urals, where the expansion of flax acreage is limited by a shortage of labor

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to process it; intensification and expansion of grass sowing for seed; increasing the emphasis on legumes such as peas, lupine, horse beans, small-seed lentils, etc.; increase in the sowings of the more highly cultivated varieties of barley and wheat; the introduction of a long list of silage crops from seeds of southern origin, such as sunflower, corn, etc.; and the introduction of gold-of-pleasure and mustard, etc.

Alongside of the generally favorable climatic conditions, certain places also experience noteworthy drawbacks in this respect. The most substantial of these influences are the excessive rainfall at the end of summer and in the autumn, causing the crops to rot, and, in the north and east, the small amount of heat during the short growing season, which forces the intensification and shortening of the period of field work and prompts the search for methods of accelerating the ripening of the crops, such as change in the sowing period, forcing, transplantation of the seedlings, vernalization, growing under glass, etc.

The valuable qualities of the climate do not correspond to the character of the surface of the earth, for an immense acreage is occupied by forests and marshlands, preventing the agricultural exploitation of the territory and merely increasing the distances. It will be very costly to place such expanses under cultivation, but it is just here in this region that it will be most worth while. The profitability of investment for the reclamation and exploitation of the territories in this moist region competes very seriously with that of investment in the arid southeastern region of the Soviet Union, and deserves

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careful comparison from the economic viewpoint, particularly taking into consideration the possibilities of a vast system of power stations in the north using cheap water power distributed over the entire extent of this region, or burning coal, wood and peat, and the mechanization of land clearing and drainage operations.

The southeastern section of this region is worthy of special interest in connection with the problem of the basic amount of investment required for agricultural engineering works, such as reclamation and irrigation facilities. It embraces the southern part of the zone of mixed forests (the central portions of Moscow Oblast, Muzhegorod Kray and Ural'skaya Oblast, together with the northern portion of the Tatar Republic, with podzolic soils). Here there is no threat of extreme drought, nor of excessive moisture; the proportion of both marshland and forest is sharply diminished; and fertile loam and humus-loam soils are widely distributed. Even formerly, the possibilities of expending less in labor and other resources in the struggle with unfavorable conditions of the natural environment singled out this portion of the podzolic zone of the humid western region as surpassing in productivity the chernozem south. This applied equally to the neighboring regions of Orel and Tula and to the northern Arzamas-Tatar wooded steppe.

Now more than ever before it is essential, in connection with new agricultural equipment, to decide on the relative desirability of extending the zone of cultivation in each of these two regions. We must choose between the development of land in the southeast, which can be placed under cultivation

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with relative ease, but is situated in a region that affords less assured stability of yield, and the expansion and deepening of cultivation in the humid north.

Very much still remains to be done in the field of selection of many plant groups. The seed currently used in crop growing here represents essentially the result of natural selection from purely local types originating in a limited number of the oldest agricultural standbys. The best of these are: flax from Pskov and Yaroslav^b, clover from Kama area, Cherepovetsk, etc., timothy from Vologda, Ostrov, etc. There is no question but that it will yield extraordinary practical results if we call on the plant resources of the whole world, carry out careful and extensive investigation and utilization of the local material within the region itself, and, finally, use methods of combining in a single plant the qualities already present with the desirable qualities of newer varieties.

The milder climatic conditions here result in the activity of numerous insect pests and markedly encourage the spread of fungus diseases. The control of the Swedish fly in the deciduous forest belt in the southern part of the region represents an extremely serious problem. This belt has the most fertile soils and enjoys a warm climate, and up to now, because of this pest, it has been a barrier to the advance of the wheat-growing areas. The grain producing southern areas of the region have thus been forced to fall back on rye and oats, for the most part. Also important is the struggle with vicious pests that attack winter crops - winter cutworm moths in the north of the region and slugs in the west. A special problem, of extreme importance

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for the region, is the control of the fungus diseases which attack flax, potatoes, forage and cereal crops.

We have still hardly commenced the mechanization and technical equipment of agriculture, in the sense of adapting it to the specific conditions of the north, with its climate, soil, ground conditions, and its special northern crops. In this respect the north is still forced to get along with its own primitive equipment or, in the alternative, to employ methods and constructions designed to meet southern conditions. The cultivation of crops absorbing large amounts of labor, such as flax, hemp, potatoes, root crops, silage, etc., is still very insufficiently mechanized, and this is the principal brake on the expansion of their sowings.

The cultivation of legumes is hampered by the lack of machinery for handling, harvesting, drying, etc. A revolutionary change for the better is necessary here.

In connection with the maximum concentration of industrial settlement on the great expanses of this region between the Yenisey and Neman rivers, the concentration on this territory of largest enterprises in the extractive and processing industries, and the extensive possibilities of mechanization and use of chemical fertilizers in agriculture, should be noted. These possibilities, as well as climatic and soil conditions, favor the development of forage and bast-fiber crops, and make basic the following branches of agriculture: market gardening to supply the industrial centers; forage supply, based on sowings of grasses, principally clover, and root and silage crops, and on the utilization of improved and natural pastures and meadows,

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especially of bottom lands, and based, finally, on sowings of cereal and concentrated forage for the expansion of dairy farming producing milk, buttermilk, butter and cheese; cultivation of industrial crops such as flax, hemp, potatoes, barley, mustard and gold-of-pleasure to supply the raw material for textiles, glucose, distillery, synthetic rubber, brewing and vegetable oil industries; and finally the cultivation of cereal crops, including rye, spring and winter wheat, barley and buckwheat, so as to make the north, as far as possible, more self-sufficient in grain supply, thereby freeing the valuable southern grain crops for wide distribution, lightening the burden on transportation facilities and lending greater stability to the grain growing for the Soviet Union. This would be the truest form of insurance against years of crop failure in the south, and would also strengthen the defense reserves, etc. The fact that the coarse grains are less suitable to the conditions in the dry south and southwest of the Soviet Union, together with the absence of competition for them in the north by the more valuable grains, gives oats and rye an almost monopolistic position among the grain crops of the north.

The Eastern Monsoon Region

The region of monsoon climate situated in the Amur and Maritime Regions (or, more precisely, the narrow belts of the meadow-steppe lowlands along the middle reaches of the Amur, the basin of the Ussuri River and Lake Khanka, and the belt on the southern shore) has conditions similar for agriculture, on the one hand, to those in the humid western region we have

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just discussed, although on the other hand they approximate the conditions in the eastern region, with its rigorous winters, light snowfall, dry springs and cold soils. This monsoon region is favorably distinguished from the other two we have mentioned by the greater length of the growing period and the larger amount of summer heat; at the same time the excessive rainfall which marks the end of summer is an exceedingly unfavorable factor, causing damage from moisture and wet rot to both grasses and cereals, and strongly stimulating the spread of fungus diseases.

The basic requirements of agriculture in this region consist of the struggle with these negative climatic factors by selection of early-maturing crops and varieties, which are also immune to fungus diseases, by organizing the protection of the harvests against humidity and drought, through the acceleration of field operations by means of mechanization and technical equipment, by meliorating small-scale climatic conditions and regulating the thermic and aqueous regimes of the soils through the selection of proper crops for rotation, by making full use of the peculiarities of the relief, by regulating the timber industry, and by taking other related measures.

The valuable eastern crops are easily adapted to the peculiarities of the local climate. Soybeans, rice, etc., thus define the basic trends of agriculture. In addition to these, soil and climatic conditions also favor the cultivation of a long list of valuable industrial crops: which include flax, the valuable later-maturing varieties of hemp, beets, sunflowers, corn, a number of proso millets, sudza, etc. It is a fundamental ob-

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jective of this agriculture to expand the acreage, intensify the cultivation and increase the average yield of these valuable but labor-absorbing crops, so as to meet the needs, completely and in all respects, of this very distant borderland of the Soviet Union.

However, in accordance with these demands, the significance of the cereals is also very great here, particularly in the Amur region, where conditions, while favorable for wheat, are less so for rice and soybeans. The problem of selecting varieties of cereals able to withstand the winter conditions of this region, and perennial grasses, from the local Far Eastern flora and from that of the whole world, both cultivated and wild, is one of exceptional importance.

The Significance of the Basic Regions in the Development of Northern Agriculture

The general agricultural value with respect to the future is by no means identical for the four regions we have enumerated, because of the fundamental characteristics of their agriculture. The Far Eastern region which has just been discussed is unquestionably of the very highest value, not only for the whole extent of the Pacific border region, but, with respect to a number of crops, for the entire Soviet Union as well, inasmuch as it offers the possibility for the successful cultivation of the most widely variegated group of valuable crops that can be grown anywhere in the non-chernozem belt.

Even more valuable in this respect is the vast region of intensive agriculture in the zone of the deciduous, mixed and southern evergreen forests in the west. This immense industrial

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region can be made almost completely self-sufficient in the basic agricultural products. It can produce a colossal quantity of raw material for industry, as well as high quality flax, barley and livestock products for wide-scale distribution. It is precisely in this region that top priority should be given to the possibilities of utilizing electric power in the agriculture of the non-chernozem belt, developing a network of machine tractor stations, applying mineral fertilizers, etc., all with the objective of utilizing more completely favorable natural conditions, and creating an environment suitable for the intensified production of the more valuable varieties of the specialized crops of this region.

The agricultural potential of the trans-Yenisey region, with its continental climate and its mountainous character, is sharply reduced, in comparison with that of the other regions, by its more rigorous conditions, but viewed in perspective, the existence of tremendous sources of power and the less frequent occurrence of marshland make land reclamation easier, and make it possible to intensify agriculture, as well as to supplement the predominating cereals with a long list of other crops.

Because of exceptionally difficult circumstances in contending with swamp and forest in the harsh climate of the subpolar north, it would seem less advisable for the time being to develop agriculture in this region as a separate branch of the economy, from the point of view of intensive cultivation. But simultaneously with the utilization of natural forage resources, the organization of forage and vegetable cultivation should be able to supply completely the local manufacturing and

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trading settlements. For the immediate future, however, the basic role of agriculture in the subpolar north should be limited to supplying a small number of populated localities with vegetables and forage for the cattle of the local dairy farms.

"From Consuming Areas to Producing Areas"

In very many regions of the north, the low productivity of field cultivation and other branches of agriculture was unable to assure by a wide margin the vast majority of the agricultural population even a minimum standard of living. Consequently they were forced to supplement their miserable budgets by following a variety of non-agricultural occupations, such as home craftsmanship, hunting, forestry, seasonal migratory labor, serving as hired help, or to seek a way out by resettlement on the wide open spaces of the south and east, etc. Over a vast territory agriculture was either of poor commercial value and in most cases not adaptable to any rational plan of relocation of its various branches, or was not productive enough to satisfy even local demand. Its low productivity and its semi-consumptive character were occasioned by the complete absence of any local specialization and the broad, almost universal range of its production. All this, taken together, followed inevitably from the very nature of the small-scale production of the scattered peasant economy, which prevented both planned Socialist economic construction and increase in the productivity of labor.

In a few cases for some regions of the north, agriculture assumed more intensive, specialized forms; but these likewise offered no escape from need. As examples, the flax culture of Pskovskiy and Vyatskiy Rayons, the hemp culture of Pridesnin-

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skiy Rayon, and the market gardening of the densely populated Yaroslavskiy and Rostovskiy Rayons may be cited. This intensification only had the effect of employing a colossal amount of labor, but did not succeed at all in raising its productivity, since the necessary means of production, the necessary mechanization of agriculture and application of chemical fertilizers, and the necessary mechanization of the primary processing of the raw material were all lacking, while, moreover, the forms of labor organization were still primitive. A very revival of these regions was based only on the supply of cheap labor.

The agriculture of our north, consuming more than it produced, was still miserably poor in comparison with the productivity of all branches of agriculture operating under comparable conditions in the northern countries of Western Europe, for its universalism - producing a wide range of diverse products, regardless of efficiency - was not adapted to the conditions of the cold, damp north, with uncultivated lands so difficult to reclaim, and could not even assure a level of normal self-support.

A new era in the organization of agriculture has now been opened by Socialist reconstruction of agriculture, which has commenced the collectivization of the peasant economy and the organization of large-scale Soviet farms and is successfully developing their power on the basis of tractorization, mechanization, extensive application of chemical fertilizers, a high level of agricultural technology, etc.

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The meaning of the basic slogan for the agriculture of the north put forward by the party and the government - "Transform consuming areas into producing areas" - is that now the agriculture of the north must obey the planned assignments of the national economy, while its total production must not only entirely pay for the manpower employed by it, and normally repay the entire amount of labor and capital invested in it, but must raise its relative productivity to a level far higher than that - i.e., to a level no lower than that of our own most productive zones (which are themselves also advancing in this respect) and to a level higher than that of our best foreign examples.

This assignment is set for each of the smallest regions of the north and for every single farm. The basic character of the production in each region must be influenced by the imperative necessity for satisfying to the maximum extent the needs of industry and of the population, by the possibilities for maximum utilization of the local productive forces, and for the harmonious satisfaction, at the same time, of both local demands and the assignments of the general government plan; all under the condition of specialization and standardization, so far as possible, as processes of production itself no less than as applicable to the products already produced. Thence follows the necessity of unifying the objects of production, and in particular of agriculture - the necessity for the unification of crops on the single farm and in the region, as opposed to the multiplicity of branches and the all-producing universalism of the disorganized small peasant economy.

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This is analogous to the situation in manufacturing. Very often it appears expedient for one branch of production to link up with others. This may not only cause no damage but may even represent a benefit. In this way very complex combines may be evolved. In precisely the same way, in the agriculture of most northern regions, it is hard to imagine how it would be possible to carry on the cultivation of any single specialized crop without reference to others. Consider the hypothetical case of flax without the grasses, of the grasses without cover crops of cereals, the monoculture of cereals, or root crops, without the accumulated fertility of the soil stored up for them by other crops. In preparing an environment for the maximum productivity of this crop or that crop, by virtue of the natural and economic conditions, which shall also favor this or that basic crop, or at any rate not harm it, it is necessary to look for the most expedient components and to put together a rational combination of crops. This objective by no means can be attained by generalized undifferentiated service of each unit to the economy as a whole, but only by a rational relationship of its aspects to its principal branch.

The Transformation of the Agriculture of the North into a Productive Agriculture should be accomplished on the basis of its specialized crops, but the possibility of reducing the deficit of the North in other crops which can expediently accompany its basic crops, should serve to accelerate the tempo of this transformation. Specialization and the general raising of the level of cultivation in the agriculture of the North, if crops are properly selected and located, not only will not put these

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"incidental" crops in a worse position than the basic crops, but on the contrary, will often afford them better conditions not previously encountered. Take for example the cultivated crops, the leguminous crops and the winter crops grown with the aid of the abundant manures in the livestock raising regions, or the grains grown in regions devoted to raising potatoes and root plants.

Thus the agriculture of a "consuming" area can be made productive not only in respect to the absolute volume of production, but in many parts of the territory it can be freed of dependence on the "producing" south for a long list of products in which the North was previously a deficit area. Under some circumstances, of course, many regions of the North will still remain consumers on balance, for some time yet, for a large number of crops; but at the same time the general increase in productivity will make it possible to increase the production of this or that secondary crop to levels higher than those of the past era of local consumer production. In so doing, by making a region really independent in this respect, it will contribute to the more profound specialization of other sections of the North. In this way, by undergoing transformation into a producing region based on specialized crops, our North can be made into a producing region for many places with respect to individual unspecialized crops.

The "coarse grains" which were of extreme importance, especially for the expanding animal husbandry of the North, were outstanding as deficit crops throughout the whole of the Far North and of the Western area of the European part of the So-

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viet Union, although they constituted by far the largest component of the crop turnover - up to 80 percent and higher. In the consuming regions there is one task which deserves top priority for formulation in the framework of the general assignments of national economy regulating the quantitative composition of the crops. It is the broadening of the scale of grain production and the transformation of these regions into producing regions, sooner or later, by increasing their productivity in the favorable environment of a more intensive agriculture.

All of this, in assuring the possibility of a rapid and complete change-over from consuming areas to producing areas, should solve problems connected with the individual crops, varying for different regions, in accordance with the over-all planned directives of the national economy, taking full account of the natural environment and the character of agricultural cultivation, now rapidly changing under the influence of the rising achievements of science and technology, of power installations and equipment, and of mechanization and chemistry, based on the new Socialist forms of economic organization and on the new principles of organization of labor. The institution of shock-workers, socialist competition, the "six conditions" of Comrade Stalin, particularly the transition to the system of cost accounting, can and must rapidly liquidate the consuming character of the agriculture of the North, especially in its basic branch, the cultivation of plants.

Thus, in essence, the problem of transforming the consuming area into a producing area resolves itself, for each in-

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dividual section, into two parts: (1) the determination of the direction to be taken by the agricultural economy as a part of the general economic plan; and (2) an increase in the productivity of labor and of the means of production. Any solution of the first of these problems could be reflected to a large degree in the success of the solution of the second, just as possible perspectives for the solution of the second cannot be left out of account in solving the first. This interdependence, conditioned by an inadequate knowledge of the North, is responsible for the great difficulty involved in solving the problem as a whole and in part. Thus, the distribution of crops, being dependent upon a number of other problems which have not yet been clearly formulated, makes it necessary to consider the first steps as only preliminary experiments.

The Fundamental Conditions of Agricultural Development

The basic products which the national economy should demand from the agriculture of the North would thus appear to be consisting of coarse and concentrated feeds, vegetables, bast fibers, potato starch, grains, pearl barley, and, to some extent, vegetable oils. A project for distributing the production of these products during the next few years among the basic agricultural zones and, in greater detail, among the separate regions of the North, as well as for prescribing the character of such production, is here set forth under the subdivisions numbered I₍₁₎ - IX₍₁₎; XI₍₁₋₇₎; XII_{(1),(2),(10)} and XXI₍₁₎ - XXIV₍₆₎.

But at the same time the agriculture of the North has a number of definite demands to make on the national economy of

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the Soviet Union. These demands are conditions of its successful development, and unless they are met, the agriculture of more than half the territory of the Soviet Union will be held as formerly on the stage of a consuming economy.

The following are the most essential of these demands - demands which not so long ago were still numbered among the distant problems of the future, but which have now already taken their places among the category of practical, vital problems, admitting no postponement:

1. Continuing and intensifying the policy of organizing labor and productive resources along the lines of collectivization and of the formation of large-scale state farms.
2. The establishment of concrete assignments for the individual sections of the North within the framework of the general national economic plan; the clear formulation of the prospects for industrialization, so that agriculture can be organized to meet the requirements of the manufacturing centers with respect to food and raw materials, and to utilize their power resources.
3. Work out, scientifically, more efficient methods of utilizing the abundance of atmospheric moisture in the form of rain and snow, and of soil moisture, together with methods of taking advantage of the quantity and character of distribution of heat and light, and of low and high soil temperatures.
4. Investigate the soils with reference to their agronomic value under a socialist system of agricultural organization and compile maps based on such findings.
5. Determine which regions yield a greater return on investment on intensive exploitation of reclaimed lands and on

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reclamation of new lands, in comparison with the South of the Soviet Union and with the border zones of the non-chernozem belt.

6. The struggle with distance. Survey and construct railroad and non-railroad lines of communication. Improve and mechanize transport by horse, reindeer, etc.

7. Use for reclamation and agriculture the colossal amounts of power resources stored up in the rivers, forests, swamps and ground of the North, especially important for the thinly settled regions of the North.

8. Work out, scientifically, methods of reclaiming forest and swamp lands, of land clearing and draining. Clarify the types of improvement which yield the highest returns in reclamation work. Work out methods of protecting valuable land, such as protecting flood plains against swamping, and becoming overgrown or filled with sediment, etc.

9. Carry out widespread mechanization, especially in growing intensive, labor-absorbing industrial crops and cultivated crops. Provide agriculture with the technical equipment to utilize fully the favorable climatic factors and successfully to cope with the unfavorable factors. In connection with this, organize the drying of larger quantities of vegetative products and of seeds, flax and hemp straw, hay, vegetables, etc.; build and use silos; prevent harvest rains from rotting the crops; mechanize sowing, transplanting and harvesting, especially of flax, grasses, root plants, silo and grain legumes; adopt measures to stimulate the ripening of crops and shorten their stay in the ground by carrying out the principles of vernalization, by exposing the roots to the light, and by transplanting the seedlings; pro-

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protect crops from the harmful action of low temperatures; utilize the natural light of the long day, as well as electric lighting, in growing vegetables, berries and flowers (thermal culture and electrified culture), employing hothouses, hotbeds, seedling beds, screens, mulch, etc.

10. Intensively apply chemical fertilizers to the soil. Utilize the colossal Northern deposits of phosphates, potash, lime, and peat, and provide for the efficient and economic utilization of manure.

11. Intensify the level of agriculture by providing more power equipment to compensate for the difficulties of land reclamation and exploitation, in accordance with the availability of immense supplies of moisture and with the possibility of tremendously increasing soil productivity. We may mention in this connection green fallow stubble, intertilled and mixed crops, the two hay-harvests, the use of cultivated pastures in the rotation of crops, etc.

12. Select, introduce and incorporate the use of new or hitherto unpopular crops and varieties: badan, legumes, mustard, lupine, seradella, sweet clover, Jerusalem artichokes, corn and sunflower for silage; gold-of-pleasure, rice, soy^{bean}, sudza, etc.; extra-early varieties of barley, as a green fallow grain crop; early varieties of industrial potatoes for the sandy soils of the Far North; the northward and eastward advance of flax and early hemp areas, etc.

13. Control plant diseases and plant enemies, especially with respect to flax and potatoes.

14. Institute the effective allocation of crops and their

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varieties among the great regions and, in detail, among their smaller subdivisions.

Against the background of a long series of questions as yet insufficiently detailed, we have to approach the solution of these problems by way of preliminary experimentation. The character of the agriculture in the North has been superficially sketched in the preceding pages under a breakdown of only three rough divisions of this colossal territory. Although there may be marked variations among the smaller subdivisions, this character is still, as a general rule, everywhere more or less under the influence of the above enumerated factors which operate to check or to stimulate the progress of agriculture in the North.

The rapidity of the transformation of this area of swamp and forest into productive areas depends upon the energy with which we press the preliminary studies and the way we utilize in a practical manner some of these factors, and eliminate others.

I. SEVERNYY KRAY

The immense territory of this kray, located as it is in a zone of extremely harsh subpolar agricultural conditions, is very significantly differentiated with respect to the possibilities for cultivation. The extreme northern tundra beyond the Polar Circle lies outside the limits of cultivation, but the southwestern Sukhon Region, which enjoys a warmer and more temperate climate, and yields the most reliable crop of coarse grains of any area in the Soviet Union, offers broad possibilities for the development of flax-growing and even affords considerable scope for the cultivation of the earlier varieties

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of spring wheat. The basic direction of agriculture in the Kray is conditioned by the exceptional extent of its forests and by its relatively numerous navigable rivers. Forestry operations, together with the mechanical and chemical processing of lumber, constitute the leading branches of industry served by the local agriculture. A large part of the population requiring products of vegetable origin is also occupied with fishery on the White Sea, Barents Sea, and the rivers.

The development of agriculture is limited not only by the harsh climate but also by the altogether exceptional proportion of swamp and forest land, as well as by the low natural fertility of the soils. The hard struggle with swamp and forest has not yet delivered the Kray from its extreme shortage of arable land, which still keeps it in the ranks of regions with large deficits in cereals. Up to the present time, this circumstance has been sharply aggravated by the prevailing lack of roads.

In the near future, however, the present tension in the Kray with respect to cereal supply should be eased by the development of the Northern Sea Route, the construction of a number of new railroad lines, the Volga-Pechora-Vycheгда waterway and the network linking the White Sea with the Baltic, as well as by equipping of the seaports, expanding the maritime and river fleets, etc., and by increasing the construction of forest roads.

The extreme difficulty of reclaiming new land for tillage - a difficulty which is far greater here than in any other region of the Soviet Union - places Severnyy Kray in a disadvantageous position with respect to the allocation of labor and ma-

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terial for this purpose. In such allocations, our South has priority, since it requires lower unit expenditures and can repay them by producing more valuable crops.

The Kray includes large areas suitable for forage production.

The pastures on tundra, swamp and forest lands, together with the hay harvests, are neither highly productive nor of high quality, though they occupy a very extensive total area. The flood meadows which extend along the rivers and lakes and surround the swamp areas are far more valuable in this connection. The belts of forest clearing along the rivers furnish relatively excellent pasturage. These forage resources form the fundamental base of agriculture here, and dictate its basic direction, which is butter and milk dairy farming, with hogbreeding, based on dairying, in a subordinate position. Field cultivation should be adapted to these circumstances, and yield feeds in the forms of more nutritive hay, silage, root-plants, and concentrated feeds. The tremendous role that this feed cultivation will play in providing future stocks will be entirely clear if we consider the extreme length of the stall season for cattle in Severnyy Kray and the inadequacy of the assured pasturage for the milk-producing stage during the summer. But at the same time, in the immediate future, agriculture still must play a great and indispensable part in supplying the rural population with cereals, and, in sharply increasing measures, in supplying vegetables to the urban population and those in the lumber industries.

Conditions in the southern portion of the kray give its

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flax fiber a world-wide renown. Its quality is the highest of any produced in the Soviet Union. For this reason, as mechanization and industrialization of this southern region proceeds, the future specialization of this section will stress more and more a combination of animal husbandry and flax-growing.

As communications are developed and the kray is supplied with cereals from other regions, more and more of the local acreage now devoted to the difficult cultivation of cereals should be made available instead for growing forage crops, which are easier and more advantageous to grow. But even at the present time, the forage base can be very significantly developed by more efficiently organizing crop rotations through the practice of green fallow, by plowing the less productive meadows and pastures, by using the newly cleared areas of the timber sovkhozes, reclaiming marshes, improving of existing hayfields and pastures, introducing new forage crops, using for silage the less valuable varieties of swamp and forest plants, and reducing the acreage under cereals.

The following are the most decisive of the economic and natural factors in the kray which condition and prescribe the allocation and selection of crops among the various areas of the territory: the places and regions of concentration of the industrial and agricultural population and the communications between them; the length of the growing season and its thermal regime, and the distribution of swamp, bottom land and forest areas. The principal demands on the varieties of cultivated plants may be summarized to include suitability for the maximum utilization of the very short growing period, the small amount

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of heat, and the very great amount of light, together with ability successfully to withstand unseasonable frosts, the abundant autumn precipitation and the saturation of the soil with moisture.

The separate regions of Severnyy Kray differ very markedly from each other in all these particulars.

I. The Tundra-Pastoral, Usa-Pechora-Kaninskiy Rayon. It includes the tundras of Bol'shezemlya, Timan and Kanin, and of the islands in the White Sea and Barents Sea. It is a treeless tundra, changing at the southern part to a stunted forest growth, underbrush of wooded tundra, and moss-covered marshlands. Administratively it is in Nenets Okrug and the northernmost belt of Komi AO.

Climatic conditions are exceedingly severe. The average duration of the frost-free period (above zero degrees centigrade inside a booth) in the southern section of the region is only 60 - 70 days. Only in this southern part does the average July temperature rise as high as 10 - 12 degrees, while during this same period it falls in the north to 2 degrees and lower. The total heat of the growing season is only 1000 degrees even in the South, and corresponding to this total heat, the average length of the growing season (the period with mean diurnal temperatures exceeding 10 degrees) does not attain even the minimum necessary to support the least exigent of the field crops. At the same time the winter is unusually severe, the mean January temperature in the east falling as low as -39 degrees, with very light snowfall and powerful winds. In spite of the extremely light precipitation (compared to a total annual precipitation of 325 millimeters

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at Saratov), the low rate of evaporation favors the development of strong marsh-forming processes, while the small quantities of snow, the presence of a mossy cover, and other factors, result in a perpetually frozen subsoil.

The soil cover of the region is composed of peats and sands, and more rarely of primary soils in the form of slightly turfey podzolic loams and sandy loams.

One of the favorable natural factors is the long period of extended daylight. In the summer the sun does not set all during a period up to two months.

The utilization of this factor makes it possible to develop market gardening in sheltered locations, if the plants are protected from the chilling action of the winds and fogs from the sea. Hothouse vegetable-growing is more reliable. Besides this, under more favorable circumstances, potatoes and turnips can be cultivated on a farm-garden scale on slopes with southern exposure, light soils and low ground-water levels. All methods of accelerating maturation should be used here: exposure of the roots to light, selection of fast-ripening varieties, etc.

The basic forage source for the reindeer of both nomadic and sedentary Nenets is reindeer moss (*Cladonia rangiferina*) and swamp vegetation, mainly of the sedge family, pastures with variegated grasses and underbrush, flood plains, willow shoots and birch shoots. The occasional herds of cattle belonging to the Russian population feed on the same forage, but with the addition of the rich hay harvests of the flood plains. Sedentary commercial reindeer breeding must also base itself on these same flood plains. In spite of the very small area of open space available for cultivation, the

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composition of the forage can nevertheless be considerably improved by sowing oats and barley for green forage and for straw, and mixing them with peas or winter vetches in the spring sowing. In exactly the same way meadow areas in the more favorable locations, after removing the moss cover and draining, can be utilized more rationally for both grazing and harvesting by additional sowings of timothy, Kentucky blue grass, foxtail grass, bentgrass, and red fescue grass.

The general dissemination of these crops requires the obligatory provision of seed material for the annual supply of the region (in the case of oats, peas, vetches and vegetables) or replacement in the event of inadequate maturation, of potatoes, barley or grasses, by stocks on hand in both cases. The problem of the propagation of seed potatoes, in view of the distance of this region, takes on exceptional importance in this instance.

Two circumstances particularly emphasize the necessity of developing local vegetable growing. The first is the prevalence of scurvy, here, a disease which can easily be prevented by using products containing Vitamin C. Market garden greens and other vegetables in this connection are the best prophylactic. The second reason is that the trading fishing, prospecting and other expeditions, together with the observation, ^(u)meteorological, radio and other stations of the North Sea Route, etc., are forced by the shortness of the navigation period in the northern seas to break off contact with the mainland at a time when it is still impossible to supply them with fresh vegetables. There is not the slightest doubt that extremely good results can be attained here by organizing local bases for growing green vegetables along the shore zone and

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on the islands, using glass and cellophane to prevent the loss of heat, and providing heat and light for hotbeds and hothouses through the use of coal or peat, or wood at the river mouths, the waste heat of the machines in the vicinity of mechanical installations, and also through the use of the energy of the wind, which in the North is colossal in amount, and unfailing. Indiga, the projected Arctic seaport of the Volga-Pechora waterway, which will be one of the greatest trading centers not only of this region but of the entire northern coast of the Soviet Union, will play a particularly great part in the solution of these problems.

On the mainland sections of the region, as well, potatoes and vegetables are no less important for their dietetic and antiscorbutic properties, and as a supplement to the fish and meat diet of the population. They obviously cannot be replaced entirely and at all times by the region's rich natural resources of berries and mushrooms, while consumption of raw meat leads to an endemic infestation by intestinal parasites among the population, running up to 90 percent and even higher according to data collected by parasitological expeditions.

It must be stressed that the problems of the improvement of the reindeer pastures, which constitute the basic natural endowment of the region, demand the most immediate attention. Even if livestock technology has recently commenced to pay considerable attention to the expansion of reindeer breeding for both production and traction, farming has still done very little for the reindeer. Problems which demand the most urgent study are those posed by a general understanding of the reindeer mosses, by methods for enriching them and utilizing them to better advantage, by ways of increasing the significance of the flowering plants, and particularly of the an-

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nuals, which the tundra lacks almost entirely, and by techniques of combined utilization of the pasturage offered by the extremely rich meadows, especially those under canary grasses along the Pechora and other rivers. Without such studies, enhancement of the profitability of reindeer breeding is entirely inconceivable, as is the transformation of this and neighboring regions into areas productive on balance.

I₂. The Mezen'-Pechora Region of Oasis Agriculture. The considerable difference in climate and surface conditions between the extreme eastern and the western section of this region require its subdivision into two parts: (a) a lowland subregion with a more moderate climate; and (b) an eastern highland subregion, with a more continental climate.

(a) The northern section of the former Arkhangelsk Okrug and the northwestern section of Komi AO. This western lowland subregion differs considerably from the preceding tundra region in the greater duration of its frostless period, which is 90 days long, on the average, and in the somewhat more favorable temperature conditions during the growing season. The mean July temperature here is 13 - 15 degrees, and the total heat of the growing period goes as high as 1000 degrees in the south. Since the evaporation is low, the annual precipitation, ranging from 325 to 400 millimeters, is excessive and causes the development of swampy conditions throughout the region. Winters are very rigorous, especially in the east. Snowfall is light, and the mean January temperature drops to minus 15 degrees in the west and as low as minus 22 degrees in the east.

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The region is exceptionally swampy and forested. The stunted forests consist mainly of deciduous trees and pines and of the inferior varieties of spruce, cedar and fir, which give a low yield of timber for sawing. Most of the areas not occupied by swamps have sandy soils, while, towards the west, along the Mezen' River and westward, soil cover is shallow and consists of turfy-podzolic sandy loams, loamy and argillaceous soils. There are also belts of alluvial soils on the flood plains in the valleys of the great rivers.

This subregion has the largest amount of unarable land in all of Severnyy Kray. In the more suitable places for agriculture, terraces have been constructed on the river valleys with natural sources of surface and ground water, and for this reason, they are less subject to swamping. Some of the most important sources of forage are the rich flood plains on the middle course of the Pechora and, to a lesser extent, on the other rivers. Many forest areas along the rivers have also been more completely cleared to provide pasture lands, which are much more valuable than the former forests, with their prevalent moss cover.

It is a region of comparatively non-intensive forestry, and, in the downstream areas, of industrial processing of lumber as well. To a high degree, it is also a region of reindeer breeding, fishery and hunting. Field cultivation is severely handicapped by the harsh climatic conditions and poor soils, but is still able to supply some cereals, though incidentally and in very insufficient quantities, especially in regions remote from the main routes of communication. However, conditions are more favorable for forage production, and this fact makes it more expedient to promote the development of ani-

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mal husbandry in the subregion: commercial reindeer breeding between the rivers, particularly on the high divide between the Pechora and Mezen' systems; and cheese, butter and milk dairy farming along the rivers.

Until the introduction of forest and swamp tractors, the development of the lumber industry will require a more reliable assistant than the reindeer, namely the horse, whose extensive use throughout the North demands the expansion of hay production.

The industrial population of the subregion is being considerably increased as a result of the expanded activities of sawmills, plywood mills, wood pulp plants and other woodworking and wood-processing establishments, the organization of lumber storage areas on the pechora, Pesha, Mezen' and other rivers, and especially the development of the mining of the Pechora coal deposits along the Pechora, Usa, Varguta and other rivers, the Ukhta oilfields as well as the activity on the Volga-Pechora waterway. To supply this new population it will be necessary to establish vegetable growing centers, mainly in the belts along the arterial rivers.

In accordance with the natural and economic features of the subregion, primary emphasis should be placed on the group of field crops which consists of the forage crops and vegetables, and least emphasis on cereals, which are mainly brought in from other regions.

In addition to the natural grazing lands and pastures on the immense areas not yet placed under cultivation, the cultivation of forage in the populated areas should also have a great significance. Besides plowing up new acreage to supplement the natural forage resources, it is also possible to develop widely, for green forage or hay, green fallow sowings of oats, barley, oat-pea mixtures, or

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winter vetches. Winter rye should be sown in the autumn to eke out the forage for early spring feeding, when, after the long winter, the shortage of forage is particularly acute until the new grass is full grown.

These crops, and also the stems and roots of turnips, (Vyshgorod sort), supplemented by weeds, together with forest and swamp plants, can furnish material for silage.

The early varieties of potatoes, such as Epicure, Snezhika, etc., could also be widely sown for fattening feeds during the first half of the long winter.

The forage base is composed in the main of the following components: the grazing lands and pastures should be improved by additional sowings of such early grass mixtures as foxtail grass, Kentucky blue grass, fescue grass, and red timothy, and of such late grass mixtures as timothy, late meadow grass, white bent grass, red fescue grass and Kentucky blue grass.

The cultivation of eating potatoes to supply the industrial and trading population here should be carried beyond the scale of market gardening, provided sites with advantageous soils and topography are chosen.

As far as grain crops are concerned, the climatic conditions permit the regular and reliable cultivation only of barley, and even this is possible only by using the earliest varieties and by sowing only on dry, sheltered, light and well fertilized soils. The Pioneer variety of barley, which is extra-early and gives a high yield, may be recommended in this connection. In view of the great severity of the winter, the prospects are far bleaker for the cultivation of winter rye or of spring wheat, which matures later than the early

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varieties of barley. Nevertheless the immediate need for cereals requires cultivation of these two crops to be continued, even though on a distinctly subordinate scale. The early local varieties may be used.

(b) The North Ural bare mountainous subregion, comprising the eastern mountainous belt of Komi AO.

On the north, on the high levels of the cliffs, there is tundra vegetation, the Alpine flora of the Urals. Lower and farther to the south there are spruce-fir forests, with cedars and deciduous trees, with moss-cover in the ofrests and numberless peat-moss bogs.

Climatic conditions are very severe: the frostless period is 50 - 70 days, the total heat of the growing season is considerably less than 1000 degrees, the mean January temperature falls as low as minus 23 degrees. No flood meadows are formed in the narrow valleys with their rushing mountain torrents. The soils are undeveloped, podzolic-gravel, skeletal, and marshy. It has more game animals and birds than any other region in the Kray. Firs, spruce, cedar, and deciduous trees - varieties of little value even when well developed - here are stunted and gnarled, with their timber showing a high degree of defectiveness, which reduces its industrial importance. The narrow forest belt in the immediate vicinity of the Pechora River may have more commercial value of the development of cellulose production. This subregion is primarily a hunting and pastoral area which is cut off from the main channels of communication. Agriculture is possible here only in the exits from the valleys of the mountain torrents in the southwestern section of the subregion, but even here crops are erratic and unstable. The di-

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rection of field cultivation should first of all be defined by measures to improve the poor pastures and meadowlands by sowing the perennial forage grasses, including timothy, Kentucky blue grass, foxtail grass, red top, and red fescue grass. The infrequent "islands" of arable land of this isolated subregion should meet the demand of the population for vegetables and cereals, and, when new acreage is plowed up for this purpose, for forage for dairy cattle as well. For the latter purpose oats, a mixture of oats and peas, or winter vetches, can be sown for green fodder from seed brought in from other regions. Barley and Barley mixtures can also be used.

Barley is the most hopeful grain crop for the south of the subregion. Winter rye is more doubtful and not without risk even in the southwest, but it can be used as a secondary crop. Varieties include Pioneer barley and local rye.

I(3). Mezen' - Onega flood-plain - pasture region of oasis agriculture, embracing the central areas of the northern pine forests, without broad-leaved trees or the broad grasses. The western part or subregion (a) consists of forests of western type; in the eastern part or subregion (b), we find forests of the eastern type, with firs, deciduous trees and cedars.

Administratively it consists of the southern part of the former Arkhangel'sk Okrug and the northern part of the former Nyan-dom Okrug and Severo-Dvina Okrug.

This region is distinguished from the preceding regions by the greater duration of the growing season, by warmer summers and less severe winters. The frost-free period is about 100 - 110- days, the total heat of the growing season ranges from 1000 to 1400 degrees, the mean July temperature is 15.5 to 16.5 degrees and falls

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in January to minus 12 degrees in the west and minus 16 degrees in the east. The climate of the southwestern Onega subregion (a) is far less severe than that of the northeastern Mezen' subregion (b).

The marshy character of the region is very pronounced. In the soil cover of the bottom land areas, peat-podzolic sandy loams predominate in the basin of the Onega and Pinega, while peat-podzolic argillaceous soils predominate on the slopes of the divide between the Mezen' and Severnaya Dvina. Belts of sandy soils run alongside the rivers. The wide valley of the strongly flooding Severnaya Dvina transports alluvial flood-plain soil. Such soils are less prevalent along the other rivers with more limited watersheds. The forests are also distributed in accordance with the distribution of the different sandy and argillaceous soils. The more valuable forest areas are situated in the southern part of the region, on the lower reaches of the Vaga and the middle course of the Severnaya Dvina. In this area pine and spruce forests are concentrated, with large yields of lumber, while the forests along the Mezen' and Onega rivers have only a mediocre value in this respect. The fine grain of the timber, which is a consequence of the short growing season, is the most valuable quality of the forests in this region.

The soil and climatic conditions are unfavorable for the cultivation of cereals.

As a result of its forest wealth, the existence of a ramified system of navigable rivers, the availability of rich flood plains and the relative security of cereal transport from other regions by way of the rivers and the Arkhan'gelsk Railroad, agri-

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culture in the region is directed mainly toward market-gardening, dairy and livestock farming, and hogbreeding, with fluid milk production in the Kholmogora - Archangel section and principally butter production, with its attendant hogbreeding, in the other places.

In spite of the existing shortage of arable land, the requirements of the dairy cattle for succulent summer forage must and can be completely met by increasing the areas of newly cultivated low-productive forage lands, and by placing the natural grazing lands and pastures in a condition of cultivation through clearing, if located on forest land, draining where marshy, liming; making additional sowings of the perennial grass mixtures discussed under the preceding regions, protecting the flood plains from silting, and similar operations. Autumn sowings of winter rye can be used for early spring fattening and grazing, while first-year perennial grasses and clover aftermath can be used for the same purpose in the autumn.

The cultivation of new acreage to supplement the hay from the flood plains should assure the forage supply during the long period of stall confinement. The supplies of hay may be augmented by cultivating late red clover mixed with timothy containing Swedish clover, and also by sowing timothy, either without admixture or mixed with the perennial grasses such as red fescue grass, meadow fescue grass, foxtail grass, meadow grass and red top.

The succulent winter forages should consist of tubers: potatoes and turnips, together with silage from weeds, forest and swamp grasses. Silage should also contain mixtures of oats or barley with vetches or peas, silage tubers, together with haulm, cabbage leaves, first-year perennial grasses, and waste from potatoes and vegetables.

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The cultivation of eating potatoes and truck garden vegetables should assume a much greater relative importance, especially in the regions at the mouths of the Onega, Dvina and Vashka and in other populated areas, as well as in the south, in the area of greater development of forestry. In the vicinity of Arkhangel'sk the cultivation of potatoes may also have great industrial importance.

The marked insufficiency of cereals will force us to give great attention during the next few years to the grain crops. Early barley and winter rye are the basic grain crops here, and are of equal importance. The early ripening variety of barley called Pioneer may be recommended here, while local ryes may be used for the time being.

The outlook for peas, spring wheat and oats is less hopeful here, but in view of transportation difficulties and to improve and vary the diet, they may be cultivated as secondary crops. For want of sufficiently early ripening varieties, however, it is only possible to assure uninterrupted cultivation of these crops if known sources of reserve seed are available in case of failure in some years to complete the ripening cycle. In general it should be noted that here, as in the case of the preceding regions and some of the following ones, seed material entirely adapted to local conditions should be obtained through local selection work. During the immediate future the entire difficult zone of unreliable oasis cultivation in the North will be forced to content itself, for the most part, with local sowing material.

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I (4). Izhma-Pechora region of oasis cultivation. Northern ever-green forests sharply emphasize the eastern tinge: Siberian spruce, fir, cedar, etc. Administratively it is in the central part of Komi AO.

It is distinguished from the preceding region by its considerably more continental climatic conditions, thus making it less suitable for the development of agricultural cultivation. The frost-free period here lasts only 70 to 90 days, which in itself limits the possibility of cultivating such crops as oats, spring wheat, peas or spring rye. The total heat of the growing season, however, is not lower than in the preceding region, totaling 1000 - 1400 degrees, which fact is connected with the considerably lower amount of cloudiness and the higher summer temperatures. The average July temperature is 15 - 17 degrees. While summer is hot and much shorter here, winter is cold and much longer, with average January temperatures from minus 18 to minus 20 degrees, though snowfall is considerably greater than in all the preceding zones.

The region is very swampy. Soil cover is exceedingly variegated, consisting of peat, podzolic loam, sandy loam, argillaceous, sandy, coarse-grained, and skeletal soils. The relief is more diversified than in the preceding zone (Timan ridge, spurs of the Urals), and in connection with this, and also with the limited areas occupied by the watersheds, the rapidly flowing rivers, more confined within their valleys, do not form as broad flood meadows as in the preceding zone. In spite of this, the area of such meadows is considerable. Ground cover in the forests is principally moss. The forests are of relatively low value, both in the composition of their stands and the quality of the timber, which for the most part is

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cellulose and not usable. The region is rich in game, birds and fishes, and is mostly devoted to hunting and forest industries. The construction of the Kama-Vycheгда-Pechora route will shortly increase the number of the industrial population, and, in the future, will lead to the marked industrialization of the region on the basis of the broader exploitation of its lumber. The route will also supply the region with cereals. In the immediate future it is planned to commence the exploitation of the petroleum deposits in the basin of the Izhma, and of the coal and a number of other minerals in the Ural mountain chain. This will make it imperative to organize widespread centers for vegetable growing.

Owing to the limited possibility of grain cultivation, in spite of the very great need for cereals, and also because of the future industrial development of the region, its agriculture will be devoted to dairy farming, related branches of animal husbandry, and to vegetable growing.

The poor forage areas in the form of swamp and forest lands should be placed under cultivation by clearing, draining, additional sowings of perennial grasses, etc. so as to assure a sufficient supply of succulent summer forage to meet the requirements of the cattle. Succulent winter forage can be assured by sowing potatoes and turnips, and, for silage, fescue grasses or mixtures of barley with vetches and peas, silo silage tubers, haulm, roots, first year perennial grasses and wild plants.

For hay, timothy may be sown, either alone or in combination with late red and Swedish clover or the following perennial grasses: meadow grass, red fescue grass, foxtail grass, red top and fescue grass. The sowing of oat-fescue mixtures for green fattening forage, hay and silage should be widely practiced here.

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The sandy loams along the Izhma, Pechora and other rivers should be extensively used, after application of fertilizer, for cultivating potatoes.

Barley is the grain crop that is safest under the climatic conditions, and winter rye to a much lesser extent. These two grains should remain the principal grain crops here. The Pioneer variety of barley may be recommended. In growing rye it is imperative to select the most secure locations in view of winter conditions. For the time being, local seed material must be used. Winter wheat and oats offer less hopeful prospects, but for the immediate future, to lend variety to the diet, they may still be cultivated if the very earliest varieties are used. However, they should be grown only on a distinctly secondary scale, with even less emphasis on winter wheat.

I (5). The Vaga-Dvina-Vycheгда flood plain region. The southern transitional belt of the northern evergreen forests, with infrequent transitions to broad-leaved species and to the broad grasses. Administratively it consists of the southern part of the former Nyan-dom Okrug, excepting its extreme south, and the central part of the former Severo-Dvia Okrug.

This region already enters the zone of the completely stable agriculture of the North. Along with the broader dissemination of valuable natural vegetation, the greater amount of heat and the more temperate climate afford the cultivated flora broader possibilities for development. The frost-free period here is short generally 110 - 115 days, but the total heat of the growing season already reaches 1400 - 1600 degrees, while the average July temperature is 17.0 - 17.5 degrees. At the same time the winters are considerably milder,

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with average January temperatures ranging from minus 12 degrees, in the west, to minus 15 degrees in the east, and snow cover from 50 to 80 centimeters (maximum depths of snow cover, averaged over a period of years). The western Onega part of the region, which is located west of the boundary of the eastern type forests, is distinguished by particularly mild climatic conditions at the edge of the zone. The annual precipitation is 475 - 500 millimeters and the total precipitation during the growing season is 200 - 250 millimeters, both being extremely high in relation to the evaporation, especially in the southwestern part of the region.

The ground cover is very varied. There are broad belts of alluvial soils in the valleys of the large Dvina and Vychegda rivers. Belts of sandy soils usually run along the other river valleys. The areas of the divides are occupied by peat-moss podzolic soils, consisting mainly of clays and loams to the east of the Vaga River and of sandy loams to the west of it.

The areas of the divides are very swampy and heavily forested; but the naturally drained terraces in the river valleys, together with the cleared belts along the floatable rivers, are relatively free of swamp. The Kargopol' agricultural region (I5a), with its fertile soils, has been more widely cleared of forest. The growing season is longer here than in the preceding regions, and consequently forest renewal and forest growth is more intensive. At the same time it is short enough to assure a fine grained structure of the timber, which is a valuable quality of the local woods. The development of frost-damage and internal cracking defects which occur in more northern and more eastern forests is prevented by the lesser degree of winter frost. The pine and the spruce on sandy soil cemented

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by clay grow along the floatable rivers. Among the tree species of the region the fir and cedar, with their low value, occur only very sparsely, vanishing completely in the western areas. Drift conditions are good on the Dvina, Vychegda, Sukhona and Vaga rivers.

In general the region is one of very valuable woods, and affords wide possibilities for the exploitation of the forests and the development of forest industry in comparison with which the other occupations, agriculture, fishery and hunting, are relatively minor.

The region can rapidly be turned into a surplus area with respect to animal husbandry and vegetable growing, while cereal production, as new acreage is brought under cultivation, can be expanded to supply the needs of the local agricultural population. In the southern part of the region, fiber flax of very high quality can be grown.

The riparian flood-plains which constitute the main base of animal husbandry, and the forest pastures and grazing lands, which serve as a supplementary base, are capable after improvement of completely assuring the necessary supply of succulent summer feeds required by dairy cattle, and also, to a significant extent, of supplying the necessary hay. Owing to the lesser density of the forests the forest pastures in this region are far more extensive than in the preceding regions, but their productivity is almost as low. In the forests that are more remote from the river valleys, the moss cover is continuous. The vegetation of the grassy marsh lands is very insufficiently utilized. In the zones along the rivers, the gradual reduction of the forest areas is resulting in very marked deposition of sand and silt on the flood plains, and in consequence,

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reducing their area and impairing their quality. Their quality can be improved and productivity increased many times by suitable protective measures, including clearing of pastures and grazing lands in the forests and draining those on marshlands, and simultaneously improving them by a number of agrotechnical methods, as well as through the additional sowing of perennial grasses.

In this connection we must duly take into account the fact that an increase in hay supply is particularly urgent in view of the necessary use of a greater number of horses in forestry operations during the immediate future. The present custom of bringing in hay from Kazakhstan, the Central Asiatic Republics, and other places, should be relegated to a position among the curiosities of the past.

The following assortment of grasses can be used for additional sowings to improve the meadows: timothy, meadow grass, fescue grass, foxtail grass and bent grass. On fields cultivated for hay it is already possible to sow the following successfully: late red clover with timothy, supplemented by swedish clover, unmixed timothy or timothy mixed with such perennial grasses as fescue grass, red fescue grass, Kentucky blue grass, late meadow grass, foxtail grass and bent grass.

(The growing of winter succulent feeds should also include potatoes and turnips both *Brassica napus rapifera* and *Brassica campestris rapifera*.)

To provide silage, besides using wild grasses, vegetable garden and wastes, etc., it is also necessary to make special sowings of vetch-pea mixtures with oats or barley, in the furrows of other crops, and of tubers for their roots and stems, as well as of leafy cabbage. Perennial grasses may also be used for this purpose during

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their first year, as well as the aftermath of clover crops. White mustard may be planted to force heavy growth of massive green vegetation; in the south of the region sunflower can also be used for this. Special autumn sowings of winter rye should be used for the fattening rations of early spring.

Among the grains, conditions here guarantee high and reliable crops of early-ripening barley and of winter rye.

Oats are relatively not so reliable, but in general early varieties are still entirely able to retain their place as a supplementary crop. It can even be a main crop in areas of forest operations. In this case sowing on so large a scale is dictated by the need for this crop as a feed for the horses engaged in forestry.

The early varieties of spring wheat can be grown with considerable success on loamy marls with low water tables. In general, it is less productive than the coarse cereals in this region, since it is more exacting in its demands on the environment, but it should be retained as a secondary crop to improve the diet of the local population.

Peas for human consumption and for forage should also be a secondary crop, but with prospects of increasing importance. The Pioneer variety of barley is recommended under conditions which require rapid maturation (as on tilled areas surrounded by woods, where the snow cover is late in disappearing), on northern slopes, low-lying sites, etc.. For more favorable circumstances, assuring a harvest of larger seed grains, no definitive variety has yet been selected, but among the leading candidates is the variety developed by the Severnaya Dvina station. The early-ripening, low-protein

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Chervonetz variety is admissible for sowing in the Kotlas region for the special purpose of supplying the brewery. For rye, the Vyatka variety is indicated. For oats, the Kyuto variety is recommended, while the use of the Pflyug variety is admissible. For peas, the Irlandets (Irishman) variety is provisionally admissible under the best conditions.

The area of the lower reaches of the Vychegda and Sukhona rivers, i.e., the southwestern part of this region, yields by government standard the highest quality of flax fiber in the Soviet Union (fiber of first quality group). This factor should be turned to advantage where the demand stresses quality.

In general, simultaneously with the industrialization of forestry operations and the development of the mechanical processing of flax straw throughout the entire southern part of the kray, the prospects are for flax to become a crop supplementary to the forages. But it should become the primary crop in the foregoing part of the region, in the flax zones along the Viled', Lala, Sukhona, and other rivers, and on the lands newly reclaimed after forest clearing, where it is one of the best and most remunerative crops.

The demand for potatoes and vegetables has been increasing sharply with the growth of the industrial population engaged in the lumber industry, and it will also be stimulated by the impending construction of new railroad lines. Especially on the belts of sandy soil along the rivers, potatoes may continue to be grown as a supplementary crop, in view of their great importance for animal husbandry, as well as the possibility of their industrial utilization in the Kotlas, Velikiy Ustyug, Vel'sk, Shenkursk and other regions.

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I (6). The Sysola-Lusa-Vycheгда flood-plain pasture and forest region. It consists of the southeastern part of the northern pine forests, emphatically expressing the eastern tinge, with an ingress of deciduous species. Administratively it is located in the southwestern part of Komi AO.

It is distinguished from the preceding region by its considerably shorter summer and its severe winter. The frost-free period lasts only about 90 days. The average January temperature ranges from minus 15 degrees to minus 17 degrees. However, the warmth of the short summer is not lower [than that of the preceding region]. The total heat of the growing season is 1400-1600 degrees and the average July temperature is 16.5 - 17.5 degrees, but there is somewhat more snowfall during the winter. In general, the region is one of the group of eastern regions in the Severnyy Kray -- I (2), I (4), I (6) -- with a more severe, continental climate, a shorter growing season, frequent cold snaps in the spring, and severe winters. The latter two factors, together with the greater marshiness of the region, more than any other elements operate to limit the development of field cultivation.

The soils of the region are very variegated, consisting of peat, argillaceous, loam, sandy loam, and podzolic soils, while sands predominate along the rivers. In connection with the relatively short growing season and the low temperatures, there is little choice, for purposes of cultivation, between the soils on the elevations and those along the rivers; while the heavy waterlogged argillaceous soils of the water divides are less serviceable, they are also hard to reclaim. The western part of the region thus offers more valuable soils for cultivation: the "warm" and occasionally marly sandy loams and

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loams of the hydrologically more developed confluence of the Sysola and Luza rivers. The low-lying marshes extensively distributed over the region represent a rich reserve.

But the basic agricultural assets of the region are to be found in a belt consisting of the flood meadows of the Luza and Sysola in the north, and the flood-plains of the Vychegda in the west, both of them containing rich alluvial soils.

The region is one of industrial forestry, though it is practiced less intensively here than in the preceding region. Conditions in the region are more favorable to the cultivation of forage crops and early vegetables. Cereal cultivation is less promising, and acreage for this purpose is very limited unless large investments are made in reclamation. This limits the basic tendency of agriculture to dairy-farming with attendant hog-breeding.

The main forage sources are flood-plains, together with grazing lands and pastures on forest and marshland. If these latter are improved, they can supply all the succulent summer forage that is needed and also assure a basic supply of hay for winter use.

However, in order to increase the forage supply, and, more important than that, in order to improve it, as animal husbandry expands, sowing of the grasses must become more general, with clover as a base. The following sowings give excellent results in this region: clover with timothy, clover with Swedish clover, timothy alone, or timothy with the perennials meadow fescue, red fescue, foxtail, meadow grass and bent grass.

Potatoes and turnips (*Brassica napus rapifera* and *Brassica campestris rapifera*) together with silage should assure succulent winter feeds. Silage should be based on special sowings of oats or

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barley vetches and peas, mixed, on tubers and their haulm, perennial grasses in the first year of growth, on wastes and culls from plowing and vegetable gardening, on weeds and on forest and marsh vegetation. Special autumn sowings of winter rye are required for early spring fattening rations. Oats and its mixtures with legumes are of particular interest here for both fattening rations and for hay.

The lumber camps on the Vychegda, Sysola and other rivers should be assured of a supply of vegetables and potatoes, and these crops should therefore occupy a very important place among the field crops.

The western part of the region can produce flax fiber of very high quality. Flax should accordingly be one of the basic crops in the appropriate places of that part, just as in the adjacent parts of the preceding and following regions. Hemp should here also maintain its great significance as a crop yielding the raw material essential for the rope and cordage industry of this region of industrial forestry and rivers.

The region has only tenuous communications with the outside world. The single main-line route is the Vychegda River, which rapidly shoals up in summer and has a very short navigation season. This focuses attention on the cultivation of cereals, and on the chances of increasing the harvest to the level required to supply the agricultural population. Winter rye and barley can be cultivated here with complete safety, and should be considered the basic crops. Though oats mature later, early varieties can and should be cultivated as a supplementary crop to feed the horses working in the forests. The prospects are less hopeful for stable yields of peas and

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spring wheat, but as they are very important in improving the diet, their cultivation should still be continued, even though on a secondary scale, in view too of the difficulty of bringing in grain from other regions. The prospects with respect to cereals are sharply changing. When the Kama-Vycheгда Waterway is established, the prospective cereal situation will be sharply altered. The increase in the forestry population requires the broad organization of vegetable growing.

The same varieties are indicated for cultivation in this region as those noted under the preceding region.

I (7). The Sukhona flood plain and flax region. It lies in the northwest part of the zone of southern evergreen forests and consists of the southernmost part of the former Nyandom Okrug, the northeastern part of the former Vologda Okrug, and the southern part of the former Severo-Dvina Okrug.

This southern region of the Severnyy Kray is distinguished by lesser marshiness and thus by the possibility of easier land reclamation, by the greater length of the growing season, as the average duration of the frost-free period is about 115 days, and by the greater amount of summer heat, the total heat of the growing season ranging from 1600 to 1700 degrees. But the summer rainfall is an even more outstanding element in the climate of the region, for it is both more regular and greater than in the regions we have already discussed, and, in consequence, the atmosphere is very cloudy and humid. The regulatory action of the precipitation upon the thermal regime is reflected in its milder character and in the more even distribution of heat, characteristics which are typical of the fiber flax regions further to the south. According to government standard,

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this region belongs to the 2nd quality-group with respect to flax fiber.

The soils of this region consist of podzolic loams and sandy loams, which are more developed than those of the preceding regions. Nevertheless, organic and mineral fertilizers are just as necessary here. This is especially true in the case of the poorer sand-loam and sandy soils of the somewhat more densely settled strips along the rivers.

Climatic conditions of this region are no less favorable for a number of other crops. This is one of the regions giving the highest and most consistent yields of coarse grains in the Soviet Union. As an unfavorable factor in this respect, however, we must note the very extensive prevalence of the winter cutworm moth, in consequence of the wide distribution of sandy soils and the lesser extent of marsh conditions.

More favorable conditions for the development of agriculture are enjoyed by the warmer southern part of the region, which is relatively less marshy and is situated in the "belt of northern slopes" along the divide (I 7b).

It is a region of abundant forest and is very rich in valuable timber. This defines its basic economic direction together with the great significance of its agriculture.

There are railroad lines along the eastern and western boundaries of the region, and it is crossed diagonally by a navigable river. This makes it relatively less dependent upon the necessity for increasing its own cereal production.

In connection with the fact that natural conditions assure the development of a rich fodder base, the basic direction of

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agriculture is defined as flood plain milk-and-butter dairy farming, with the ancillary hogbreeding. The complications affecting the use of flood plains in this region are not as great as in the two last-mentioned regions, but for all that, the pastures and grazing lands in open ravines and in forests are far more valuable here already, and will become even more so after improvement. At the same time, the southern part of the region, which has less flood-plain and is more favorable for grain culture, could perhaps also produce some surplus in cereals and seed to supply the nearest parts of Severnyy Kray -- parts with insufficient grain and specializing rather in forage growing.

In this region, flax-growing has the best prospects of development, with its primary emphasis on quality of fiber. By improving productivity, grain cultivation can be developed, to make the rural population self-sufficient in this respect, vegetable growing can meet the demand of the entire population, and potato production can supply both animal husbandry and industrial needs.

As a secondary crop the region can produce white mustard, which ripens completely here later than the grains, as well as the medicinal herbs valerian and camomile.

The selection of forage crops to supplement the forage from the improved pastures and the hay harvests, should consist of the following sowings for hay: single-crop clover with timothy, with added Swedish clover, timothy unmixed, or timothy with the perennials fescue, red fescue, foxtail, meadow grass, and bent grass. For silage the following should be sown: oats or barley mixed with vetches or peas, tubers for use together with haulm, leaf cabbage, first-year perennial grasses and clover aftermath, potatoes and

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turnips (*Brassica napus rapifera* and *Brassica campestris rapifera*).

Grain crops in this region yield not only high and very consistent harvests, but also, according to data of Gossortoset', the coarse grain is of very high quality. However, there is usually one major inherent difficulty: in some years it happens that very abundant autumn rains are followed by early onset of cold weather. In such cases the grain may suffer a very serious loss of germinative power, due mainly to the difficulties of drying it in the field and to spoilage in the drying barn. For this reason, grain cultivation, as it develops, and more especially seed grain cultivation of all varieties, should, as a matter of top priority, be assured of equipment for proper drying. This is even more applicable to the next (Eighth) region of the Severnyy Kray.

The conditions of the region no longer require the inclusion of barley among the basic grain crops. It is entirely safe to grow winter rye of the Vyatka variety, as well as oats in its earlier ripening forms from among the varieties called Zolotoy Dozhd', which are of the cultivated type, or, if such seed is unavailable, the Lokhovskiy variety, which may be substituted. But barley should nevertheless be retained as a supplementary crop. It is useful, on the one hand, as groats and forage - mainly for hogs - while on the other hand it is one that can be used as a stand-by crop to insure against failure of rye and oats in exceptionally cold and rainy years. The variety of barley to be grown in this region has not yet been definitively established. For the time being Kol'khikum 10/30 of the former Engelhardt station, a groat type and the earliest of the two-row varieties, is admissible. The Chervonets variety may be used in

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cases requiring very rapid maturation. Among the secondary grain crops the early varieties of peas and the Novinka variety of spring wheat can be very successful. Special attention must be paid to the development of pea growing for both human consumption and forage. But the spring wheat produced along the Sukhona and Vaga rivers is also important. It lends variety to the diet of the population not only of this region, but also of the other adjacent regions of the kray, to which grain transport from outside is still very difficult. For this reason, pending the organization of a regular supply of wheat shipped in from outside for the entire kray, we should still continue to take advantage of the soil and climatic conditions (suitable soils and greater length of the growing season) that favor the cultivation of this crop along the upper reaches of the Vaga and in the Tot'ma region on the Sukhona.

I (8). The Vologda flax-meadow region. It is a transitional region between eastern and western evergreen forest, on the northern boundary of the oaks and maples, and is located in the southwestern part of the former Vologda Okrug.

The positive elements in the natural conditions of the preceding region are here considerably strengthened. The gently sloping and rolling relief and the low degree of swampiness allows wider advantage to be taken of the more fertile clays and loams which predominate in the make-up of the soil cover. This is the least forested of the regions in the kray (not taking the tundra into account) and the most widely cultivated. The growing period is longest here, being 130 frost-free days. The total heat of the growing period is also the highest, amounting to 1700 - 1800 degrees; summers and winters are warmer, with average July temperatures 18.0 - 18.5

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degrees, average January temperatures from minus 10.5 to minus 12.0 degrees, and average depth of 50 - 55 centimeters for the snow cover.

The high proportion of land under cultivation and the relatively low proportion of forest land are enough to take the region out of the category of those devoted primarily to industrial forestry and indicate the greater relative importance of agriculture. There is a large acreage of forage land in the form of river and lake-shore meadows as well as bottom land pastures and grazing grounds, of which the richest is the Sukhona lowland area. Both climatic and soil conditions favor the development of flax-growing, and these factors turn the basic trend of agriculture towards dairy farming, with its accompanying hog-breeding, and towards flax-growing. The flax fiber produced here is of high quality, rated as group 2, government standard. The conditions entirely favor consistently high yields of the coarse cereals, and these grains are of very high quality if normally dried, but the relative ease of bringing in cereals from outside the region reduces the importance of local grain cultivation to the level of supplying the rural population and helping to meet the cereal deficits of other regions in the kray.

The light soils on the Sukhona, which also occur in occasional "island" areas elsewhere, are ideal for potatoes. These should be cultivated as a supplementary crop, in view of the existence of the important industrial center of Vologda, with its large population, as well as for their possible industrial use and for their importance for feeding cattle. Mustard, valerian and camomile can be successfully grown, and should be cultivated as secondary crops.

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The cultivated pastures can supply all the succulent summer forage required by the dairy herds. The production of cultivated hay should be mainly based on sowings of late red clover and timothy, or of timothy alone or mixed with the perennial grasses fescue, red fescue, foxtail, meadow grass and bent grass. Clover should occupy the basic position in hay harvested from cultivated lands. Of the tubers, it is expedient to use potatoes and turnips (both *Brassica napus* and *Brassica campestris*). For silage, mixtures of oats, vetches and peas should be sown, together with leafy cabbage and silage tubers, which should be used with haulm, first year perennial grasses and clover aftermath. In the very near future animal husbandry will have to undertake large scale experimentation to decide the question of the expediency of special sowings of the fast-ripening sunflower varieties to furnish basic silage and of a few varieties of corn to improve the silage.

Winter rye and oats are the most promising of the grains, and are basic crops, in this region. The principal varieties are Vyatka winter rye and Zolotoy Dozhd' oats. For use with sandy soils where the supply of seed of the latter variety runs short, the Lohovskiy variety may be used. This may also be used on all soils as a supplementary variety. It should be noted that according to data of Gossortoset', this region yielded excellent malt barley in years of normal precipitation. The Professor Viner (Wiener) variety is the best barley for this region. Peas for human consumption and for forage, although a secondary crop, should be given sufficient consideration. Great attention must be paid to the development of this important crop.

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Thus, on the whole, the agriculture of Severnyy Kray may be summed up as one devoted to the production of forage, and based on the improvement of grazing lands and pastures on both flood-plains and highlands, forests and marshes; based moreover on sowings of mixed annuals, perennial grasses, tubers and silage crops. Besides this, it also includes cultivation of clover and flax in the southern half. The cultivation of grain as a subsistence crop occupies a subordinate position, as does the cultivation of potatoes and vegetables on a scale large enough to meet the general demand throughout the kray.

Together with the related areas of similar cultivation in the neighboring regions of the adjacent oblasts, the regions of the Severnyy Kray thus form: I (1) as the tundra pasture polar zone; I (2), I (3), and I (4) as the flood-plain pasture zone of potato, vegetable, forage, barley and rye cultivation; I (5) and I (6) as the flood-plain pasture zone of rye and oats cultivation; and I (7) and I (8) as the flood-plain and meadow pasture zone of clover and flax, rye, oats and barley cultivation.

II. The LENINGRAD OBLAST AND THE KARELIAN ASSR.

Two great administrative units comprise this region: Leningrad Oblast and the Karelian Autonomous SSR with the separate Murmansk Okrug of Leningrad Oblast, which, though of smaller size, is extremely important in the life of the nation. These units are organically closely linked together by developing industry and channels of communication, no less than by the exceedingly gradual nature of the transition in natural conditions.

The metallurgical industry of the Murmansk region, the construction of hydroelectric stations based on Karelian rivers and

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on the great lake basin further to the south, the existence of Leningrad, which is the greatest industrial center and port of the Soviet Union, with the industrial enterprises located in and around it, and the development of the system of rail and water routes leading to the ports -- all these combine to lend a pronounced industrial character to the entire northern part of this region. The southern part of the region is less swampy and enjoys a longer growing season, with a considerable total heat, and also has a mild winter, so that a broad industrialization of agriculture is possible. At the same time, the high proportion of forest land makes the entire northern part of the region an area of industrial forestry.

Situated as it is in the vicinity of the warm currents of the sea and possessing a huge number of inland freshwater basins, the whole region is distinguished by a mild, moderately cold climate. It lies in the zone of western type evergreen forests, from which the Siberian species are absent. In the north, these forests pass gradually into the wooded tundras, while in the south, they merge into the mixed forests which vary, mainly according to the characteristics of the soil, from the pine forests on sandy soils to the groves of oak and ash on the humus-loams. The abundant precipitation, taken together with the low evaporation and the character of the soils and relief of the region, lead to the formation of highland and lowland marshes, and to the presence of an immense number of lakes. The combination of these elements to a high degree serves to distinguish the separate parts of the region.

In considering the immense distances from north to south in this northern region, the duration of the growing period and its total heat stand out quite logically as the main natural factors

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with respect to the possibility of cultivating individual crops in any given location, and thus bounding the several plant-growing districts. While in the north of the Kola Peninsula only early vegetables can be grown, and that on sheltered sites, the central part of the region is already suitable for widespread grass sowing and grain cultivation, and the southern part assures the possibility of a broad development of the production of high quality flax and of such grains and buckwheat, malt barley, winter wheat, and others.

The generally limited quantity of heat over the greater part of the region, in conjunction with the abundant summer rainfall, is less favorable for grain cultivation and more favorable for a forage. But at the same time, the uniformity of heat distribution and its quantitative sufficiency in the southern part of the region particularly favor flax growing and help to obtain a low-protein malt barley.

MURMANSK OKRUG

(Leningrad Oblast)

There are many factors which contribute to the extraordinarily rapid development of the economy of Murmansk Okrug. The principal ones may be noted: the establishment and expansion of apatite-nephelite mining, the development of commercial fishing and trapping, the very great prospects opened by the development of the chemical industry, the exploitation of non-ferrous and iron ores, of the wealth in forest, peat-bog and seaweed, and in the reindeer-moss pastures, the existence of an open ice-free sea and of rivers with many rapids. By reason of all of these the significance of the economy of the Kola Peninsula goes far beyond local significance; yet at the same time

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the possibilities for developing agriculture are exceedingly limited by the climatic and soil conditions in this boundary region of the Soviet Union located beyond the Polar Circle. The basic tasks of agriculture here should be to produce fresh vegetables to supply the population of the industrial centers and that engaged in coastal fishing and the lumber industry, as well as to grow forage for the reindeer-breeding, dairy farming and hog-breeding branches of animal husbandry.

The construction of highly mechanized establishments for growing forage and vegetables should be decided upon immediately. These establishments should be located around the greatest trade centers and the peripheral industrial points of the mining, hunting and forest industries, namely Murmansk, Khibinogorsk, Uмба, Lovozero, Monchatundra, etc., utilizing, to the maximum possible extent, the limited available areas of meadow and alluvial soils, but principally the great low-lying marshes.

The great possibilities for the application of chemical fertilizers, for mechanization, and for utilizing the electric energy and the heat from power plants, in view of the projected increase of the population of the Kola Peninsula to 500,000 by the end of the Second Five Year Plan, permit considerable freedom in developing agriculture in this direction.

The development of reindeer-breeding to over 200,000 head poses the problem of improving the extensive pastures of reindeer moss, of utilizing them more expediently, and of developing supplementary forage bases for the reindeer-breeding state farms and collectives.

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II (1). The Murmansk forest tundra. It consists of stony and marshy tundra, of underbrush and stunted forest growth, with forest vegetation along the river valleys, and is located in the northern part of Murmansk Okrug. The frost-free period on the western shore lasts about 100 days, and the total heat of the growing season is considerably less than 1000 degrees. The average July temperature in the south of the region is only about 12 degrees.

The soils are undeveloped, waterlogged, stony and swampy. Only in the river valleys and along the lake fronts do small patches of alluvial, podzolic turf and semi-marshy soils occur. The low-lying marshlands are of most interest for possible reclamation and conversion to forage sites.

The meadow area is very small. The basic forage sites are the reindeer moss fields and the pastures with cover of various grasses and underbrush. This fact determines the basic pattern of the economy. It is reindeer-breeding. The fishing population of the region and those in the transportation industry require fresh vegetables and milk. But the conditions in the region limit the possibility of self-supply in this respect, leaving only the possibility of supplying green vegetables, mostly by growing them under glass, and occasionally, in the open. Onions, lettuce, radishes, turnips, and in some places only, the earlier varieties of potatoes may be grown.

The wind here is distinguished by ^{its} ~~the~~ greater constancy and force, and, in the organization of an artificial environment for developing vegetable growing under artificial heat and light, the question of using it should be decided first.

There are wider possibilities for improving the fodder base

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by clearing, fertilizing and additional sowings of grasses on the natural grazing lands, and also by cultivating, for hay or silage, oats and barley and mixtures of them with forage peas or winter vetches. The early varieties of turnips, etc. may also be used for silage with haulm. Sowing of isolated grass patches and improvement of the natural meadows may be based on timothy, Kentucky blue grass, foxtail, bent grass and red fescue grass.

The question of obtaining combined feeds by using industrial fish wastes and seaweeds should be solved without delay.

II (2). The lake and forest, mining tundra region. It is located in the southern part of Murmansk Oblast.

Very swampy evergreen forests, consisting mainly of pines of relatively low quality are located on broken terrain, eroded by glacial activity. There are numerous lakes with isolated areas of mining tundra which contain broad expanses of reindeer moss.

This is basically a mining region, with its center at Khibinogorsk, but it includes the lumbering, fishing and chemical industries. The task of agriculture here is, in general, to supply the industrial population with dairy products and vegetables, and also, to some extent, with meat. In its field cultivation, therefore, the basic branches are forage production for the dairy and reindeer herds, and vegetable growing.

In connection with its greater remoteness from the warm shore of the sea, the frost-free period here is shorter than in the preceding region, being 70 - 90 days, but at the same time that same remoteness makes the summers relatively warmer. The average July temperature is about 13 degrees, while in the south the total heat of the growing season is already close to 1000 degrees.

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The soils are principally stony detritus and gravel, sandy and marshy soils, with infrequent occurrence of podzolic loams. The areas of alluvial meadow soils are exceptionally limited. The best soil reserves are the low-lying marshes, but these need reclamation.

The local demand for vegetables can be met with some degree of assurance if early varieties are used and methods of accelerating maturation applied, under conditions of mechanization of the dairy-vegetable farms, in rational combination with the utilization of vegetable culls and wastes in animal husbandry, and the use of manure in field cultivation, which is here most imperative. Such vegetables are potatoes, turnips (*Brassica rapa* and *Brassica napus rapifera*), leeks, radishes and early cabbage. For the sake of variety, the immense natural resources of berries may be supplemented by developing berry patches for strawberries, currants, etc.

The forage base for dairy and draft cattle can mainly be developed from sowings of mixed annuals: oats with peas or winter vetches or, on the less cultivated lots, of oats alone; with sowing of winter rye for early spring fattening. Of the perennial grasses the following may be successfully used: foxtail grass, Kentucky blue grass, red fescue and timothy; or, in later mixtures: timothy, late meadow grass, white bent grass, meadow fescue and red fescue grasses, Kentucky blue grass; and, on more cultivated and less moist sites, with admixture of red and Swedish clover. Of the tubers, three kinds of turnips (*Brassica rapa*, *Brassica napus* and *Brassica campestris*) can also be successfully cultivated here. Tubers with haulm, oats and their mixtures, grasses of the first year of growth, and cull vegetables can provide rich material for silage.

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THE KARELIAN ASSR

II (3). The lake and marsh, forest region of North Karelia. It consists of very swampy northern evergreen forest of western type and possesses broken terrain in consequence of powerful glacial activity, with an abundance of lakes and islands of highland tundra. It is located in the northern part of the Karelian ASSR. This is a region of mining and lumbering, with centers in the Khibinskiy and Chupinskiy rayons and on the White Sea (the Kolvitskiy Chemical Combine and sawmills). The development of agriculture should be specialized to service industry as well as fishery and transport workers. The broad possibilities for developing reindeer breeding have been taken advantage of to only an insignificant extent.

The greater remoteness of the region from the warm shore of the sea cuts the duration of the frost-free period to 80 - 90 days, but at the same time this factor makes the summer hotter. The average July temperature in the southern part of the region is about 14 degrees and the total heat during the growing season reaches 1000 - 1200 degrees.

Poorly developed stony, rubbly and gravelly podzolic soils predominate on the areas of glacial deposition, with sandy loams and sands more frequent than argillaceous and marshy soils. The character of the marsh lands is very diversified. The low-lying grassy and transitional marsh lands represent the most suitable and most easily reclaimed reserves for agricultural use in the immediate future, while the stony mineralized soils of the higher marsh lands offer greater difficulties in this respect.

The possibility of grain cultivation is very sharply restricted by climatic and soil conditions, which make the develop-

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ment of the forages more advantageous. Early barley of the Pioneer or Mashin varieties can be grown, but only on the more favorable locations with mineralized soils in the southern part of the region, while winter rye and oats of the earliest varieties such as Nidar and Il'byu can be grown less frequently and with less favorable prospects.

At the same time, regional conditions assure, to a reasonably great extent, a coarse forage production high enough to satisfy the immense demand from the expanding dairy industry and from the horses used in forestry and mining, as well as a vegetable production also great enough to meet local requirements.

The forest pastures are poor in grassy vegetation. Only rarely do the rapidly flowing mountain rivers form flood meadows. The natural forage areas can be increased and improved mainly by cultivating the low-lying marsh lands and by growing annual and perennial forage mixtures, together with tubers.

The following mixtures may be grown on dried marsh land and moderately moist mineralized soils: Earlier kinds: foxtail grass, Kentucky blue grass, red fescue grass and timothy; later kinds: timothy, late meadow grass, white bent grass, meadow and red fescue grasses, and Kentucky blue grass. These may be used with admixture of red and Swedish clover on land cultivated in previous seasons. Oats give the most massive crop on reclaimed and newly cultivated land, but it is better to mix peas or winter vetches with oats if previously cultivated land is involved. Winter rye can also be sown for early spring fattening. The combined use on dried marsh land of three species of turnips (*Brassica rapa*, *Brassica napus rapifera*, and *Brassica campestris rapifera*) may also be recommended. Silage may be provided by oats and barley and their mixtures with peas and

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vetches, also tubers with their haulm, timothy of the first year of growth, and cull vegetables.

Besides the grasses, early potatoes can also be grown successfully on the drier mineralized soils. Potatoes are indispensable here for industrial uses and for the dairy herds, and should be one of the primary crops.

II (4). The lake and marshland region of Central Karelia. It is a very marshy region with many lakes, located in the central part of the region of western type evergreen forests, and showing the consequences of intensive glacial action. Administratively, it is in the central part of the Karelian ASSR.

This region has much in common with the preceding one, but is distinguished from it by the much more favorable conditions during the growing season. The frost-free period here lasts 100 - 110 days; the total heat during the growing season reaches 1200 - 1400 degrees while the average temperature is about 15.5 degrees for July and about minus 10.5 degrees for January.

In consequence of the extremely large amount of detritus in the soil and of the fact that the terrain is extensively broken by stony strata of coarse, skeletal soils, mineralized, soils suitable for cultivation are very infrequent. These are represented on the moraines chiefly by gravelly podzols consisting mostly of sandy loams and sands. The low-lying and transitional marsh lands are the main resources for expanding agriculture, and, less frequently, the alluvial soils.

It is a region of well developed forestry and wood-working industry, relatively well provided with communications - the White Sea and the Murmansk Railroad.

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In connection with these circumstances, the region needs an expanding supply of dairy products, vegetables, potatoes and forage.

Without improvement the natural forage grounds cannot assure the necessary development of animal husbandry, and they should be extended, principally by reclaiming low-lying marsh lands and by sowings of grasses.

Sowing of clover is already possible on various loamy soils. On dried marsh lands and moderately dry mineral soils, mixtures of the following perennial grasses can be grown, with timothy as the main component: red and Swedish clovers, meadow fescue, Kentucky blue grass, late meadow grass, and bent grass; while for grass sowings on fields, timothy may be grown either pure or mixed with the clovers and fescues. Of the annuals, a mixture of oats with peas or vetches can be grown successfully, and also winter rye for early spring fattening. Besides using these crops for succulent fattening rations, they may also be used for silage, together with horse beans, barley, leafy cabbage, tubers with their haulm, grasses in the first year of growth, and the aftermath of grass crops. Potatoes and turnips (*Brassica napus rapifera* and *Brassica campestris rapifera*) should be used to assure a supply of succulent fresh winter feed.

The climatic conditions sharply restrict the development of grain cultivation. The earlier ripening barleys, of which the Pioneer variety is recommended, and winter rye, are the safest grain crops. Oats are extremely essential in the regions of industrial forestry, and should be a supplementary crop, using the early varieties. The early Finnish variety Il'byu or the Norwegian Indar can be grown. Under more favorable conditions, with early sowings

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on dry mineral soils, early buckwheat can also be cultivated.

Large-scale potato growing is possible everywhere, as is the growing of an extensive variety of vegetable crops. As an industrial crop, winter cameline can be widely grown for its oil.

II (5). The Onega-Ladoga Great Lake Region. It consists of a very swampy region of western type evergreen forests, with an infrequent admixture of deciduous species and broad grasses in the forest cover, and is located in the southern part of the Karelian ASSR.

This is the best disposed region in Karelia for agriculture. Mainly on account of soil conditions, but also because of the differing degree to which the great lake basins influence the climate, the region is divided into two parts.

(a) The Olonets part, between the lakes, where the onset of spring and winter is later, the summer heat is more moderate, and the soils take the form of coarser glacial deposits which are frequently skeletal.

(b) The part lying beyond Lake Onega, where the climate is relatively more continental in character and the soils are on lighter deposits or on sedimentary rocks.

In general, the region is characterized by a longer frost-free period of 120 - 125 days, a total heat of 1400 - 1600 degrees during the growing season, an average July temperature of about 17 degrees, and an average January temperature of about minus 10.5 degrees.

Precipitation is considerably lower than in the neighboring northern and southern regions. With the stony nature of the soils, this sometimes results in very substantial stunting of the vegetation, and occasionally in burning of it by the sun, especially in the western section of part (b).

There is a considerable distribution of mossy peats. The

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mineralized soils consist chiefly of podzolic sandy loams, spread for the most part over the areas of original, untransported rocks or deposited detritus in the northern part, and of loams over the sandyclays in the south, and to some extent also in the west of the region. As in the preceding regions, stony, rubble-gravelly and sandy soils are abundant, but in general the areas of mineralized soils suitable for cultivation are considerably more extensive here. Here, too, however, the most substantial land reserves available for future cultivation are the low-lying and transitional marshlands. The region is rich in good forests, and its timber industry is rapidly expanding, but there are even greater prospects for the development of mining, metallurgy and, for the establishment of great central hydroelectric stations like Kondostroy. Good communications are assured by the development of the network of lake and river routes and by the Murmansk Railroad.

Natural conditions and the general economic environment determine the basic agricultural pattern in the region: dairy farming, with forage production for dairy cattle and horses, and vegetable growing. Flax growing has better prospects for expansion in the warmer, eastern section (b) of the region, with its more developed soils.

The list of crops for cultivation in this region is, in general similar to that of the preceding region; but a few rearrangements are both demanded and permitted by the more favorable climatic conditions, as well as by the more industrial character of the region.

Forage production here can already be based, to a much greater extent, on late red clover, the wider use of the grass mixtures indicated for the preceding zone, and on the more extensive incorpora-

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tion of potatoes and other tubers. Sunflower can also be sown for silage, in addition to the above crops. Flax may have commercial prospects. Winter gold-of-pleasure and white mustard are two industrial oil crops that can be grown with considerable assurance.

Grain production in the region has wider possibilities. If productivity is increased, it can meet the entire local demand from the village population, as well as from animal husbandry. The primary grain crops of the region are winter rye, which is the most reliable cereal for cultivation on poor soils if fertilizers are applied, and oats, which are indispensable in areas of industrial forestry. In the more industrial western subregion (a), where cultivation should be more intensive and fallow areas before the winter cereals accordingly reduced, oats should have a larger share and rye a smaller share. Use of the Vyatka variety of rye is indicated, while the basic variety of oats is the early Finnish variety Kyuto. Barley already offers less competition to these crops. Nevertheless, it may be grown as a supplementary crop, where conditions require early maturation, for use as groats and to increase the stocks of concentrated feeds. Where especially early maturation is required, the Pioneer variety is recommended.

It is entirely possible to expand the cultivation of the early varieties of peas, and this should be done. Potatoes and a large variety of vegetables can be grown in the open everywhere in the region; their production should be increased by all possible methods, especially in subregion (a) between the lakes. The importance of potatoes is greater in places with light mineralized soils, while the future of the other root crops lies mainly on the dried marsh lands.

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LENINGRAD OBLAST

(except Murmansk Okrug)

II(6), The Svir' - Vitegorsk marshland-forest region. The former Iodeynopol' Okrug. It is a zone of southern evergreen forests, mainly pines and is characterized by an abundance of peat-bogs. Grass cover is still relatively poor; an extensive moss cover exists in the forests. In the soil cover, podzolic loams predominate, based on lighter sandy clays, including coarse transported detritus. The possibility of exploiting the mineralized soils, after clearing the forest and draining the marshland areas, is far greater here than in the preceding regions of Karelia.

The climate of the region is very similar to that of the preceding South Karelian region, but it is somewhat more favorable by reason of the more southern location, the lesser extent of the lake system, and, partly, ~~to~~ the moderating influence of the Baltic Sea. The duration of the frost-free period is 115-120 days, the total heat of the growing season is 1600 degrees. The average July temperature is over 17 degrees, and the average January temperature is about minus 10 degrees. Snowfall is greater, assuring more favorable conditions for growing the perennial grasses, particularly clover. The sowing of winter rye can be introduced.

The wealth of high quality timber and the relatively good communications with the West and South afforded by the Svir' River, the lakes, the canal network, and the Murmansk Railroad, make lumbering, together with the widespread paper manufacturing, wood-working and wood-chemical industries, the primary branches of the regional economy, especially in view of the existence of the Svir' power plant together with the projected construction of power plants burning peat and wood

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fuel. These considerations, too, determine the basic pattern of agriculture in the region: production of dairy products and vegetables to supply the population engaged in the wood industries, with significant future possibilities for diverting the processed dairy products to the Leningrad area.

Soil and climatic conditions entirely permit the expansion of flax sowings if desired. Acreage not presently under vegetable or forage crops can be successfully used to raise oats, which are most indispensable for feeding horses occupied in lumbering operations, and winter rye to make the region self-supporting in this grain. Recommended varieties: Kyuto oats and Vyatka winter rye. Barley is needed to supplement dairy and vegetable wastes for fattening swine, and also for making groats. If it is grown under optimum conditions from seed of early varieties, it should also have a place as a supplementary crop. The Pioneer variety is recommended for conditions requiring particularly rapid maturation. Among the secondary crops, expansion of grain buckwheat sowings should be encouraged in every way. Special attention should also be paid to the cultivation of potatoes, which are indispensable here for both industrial and forage uses.

In the group of leading forage crops, the cultivated pastures should be the basic source of succulent summer feeds. The following may be sown for hay: late red clover with timothy, with admixture of Swedish clover, pure timothy, or timothy with red and meadow fescue, foxtail grass, bent grass, and meadow grass.

In addition to potatoes, turnips (Brassica napus rapifera and Brassica campestris rapifera) are recommended. Silage should consist of mixed oats, vetches and peas, sunflower, tubers with their haulm, leafy cabbage, first-year grasses, clover aftermath, and cull vegetables. Winter rye is recommended for early spring fattening. The organization

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of forage and hay supply by using the assortment of grasses and oats above set forth deserves special attention in the general organization of field and meadow economy.

II(7), The Leningrad-Cherepovets region of marsh and forest plains along the water divide. It is a very moist transitional zone of western evergreen forests and mixed forests, with large-scale peat bog areas.

In their relation to national economy as well as in natural conditions, there are considerable differences between the western and eastern parts of the region.

(a) The western maritime subregion has a considerably longer growing season and greater amounts of better agricultural soils. It includes the former Leningrad Okrug, the northeastern part of Luga Okrug, and the northern part of Novgorod Okrug. The subregion also includes the city of Leningrad, which is one of the greatest industrial centers in the country, ~~is~~ with its seaport and a long list of other industrial and power centers, such as the Tikhvin bauxite works, the Veymarn flax mills, the Syas newsprint pulp combine, Volkhovstroy, and Nevdubstroy, a growing lumber industry and peat digging. All these give the subregion an intensely industrial character. Land and water routes are relatively well developed.

Since the sea is so close, the duration of the frost-free period varies from 130 days in the east to 150 days in the west, while the total heat of the growing season reaches 1600 - 1800 degrees. The average July temperature is 17.0-17.5 degrees; the average January temperature ranges from minus 3.5 degrees in the west to minus 10.5 degrees in the east.

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The region enjoys an abundant summer rainfall and a relatively moderate winter. The rather high winter temperatures assure a good wintering period even with light snow cover. Stunting of winter crops often results from excessive autumn rains, excessive thawing and decay. Abundant rainfall during the growing season often does great damage. According to statistics, excessive moisture causes an average annual loss of 10 - 15 percent of the crops.

The soil cover of the subregion is very diversified. Alongside of the widespread distribution of bog and waterlogged soils, soils of glacial origin like clays, loams and sands are scattered, while in the west there are humus-limestone weakly podzolic light loams.

Forage and vegetables are of fundamental importance here, both on account of natural and economic conditions. The subregion has considerable natural forest resources in the floodplains of the Volkhov River, Lake Ilmen and elsewhere. It affords very great possibilities for grass sowings, and for expanding the sowings of silage crops and root vegetables. Hay production can be based primarily on late red clover mixed with timothy. Swedish clover can also be sown with the red clover, while meadow fescue can be sown with timothy, with additional sowings of white clover if the field is intended for grazing. This clover mixture can be used for hay and grazing 1-2 or even 3 years. Hay stocks can also be supplemented here by the high yields from oats mixed with vetches, peas, small-seed horse-beans or by combinations of these crops: vetches, peas, and oats, or vetches, peas, beans, and oats. A wider range of selection is also permissible for silage here: oats mixtures, clover, sweetclover, sunflower, forage cabbage, Jerusalem artichoke, cull vegetables, and stubble. Potatoes and turnips (Brassica napus rapifera and Brassica campestris rapifera) can be very widely

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disseminated here. There is also a considerable range of crops available for green forage, including winter rye for early spring fattening, clover, oat mixtures, white mustard and winter rape.

In view of soil conditions in the subregion, potatoes can also be grown for industrial uses, as well as for human consumption and forage. Consequently the importance of this crop here has become very great. Phytophthora blight is widely disseminated over the subregion, and this demands the introduction of blight-resistant varieties as well as energetic measures for controlling its spread.

As for the grains, the maximum[#] emphasis should obviously remain on oats for the next few years in connection with the rapidly rising level of intensification of field cultivation and the consequent shortening of winters[#]owing, in order to feed the large number of horses in this suburban and border region. Emphasis also belongs on winter rye and on barley, which last cereal is mainly needed here for hog-feed during the fattening period, though it is also required for malting to supply the local breweries. The productive two-row barley gives good results here already, and in spite of its low protein content, it is considerably superior to six row barley in protein yield per unit area, under ordinary circumstances. Zolotoy Dozhd is the oat variety officially adopted for this subregion, with Ligovo II for use on marshy soils and Lokhovskiy for light sandy soils. The Vyatka variety is selected for winter rye, ^{and} Professor Viner for barley, while under conditions requiring more rapid maturation, Kol'khikum 10/30 may be used. Development of pea culture, using early varieties, is essential.

Conditions in the subregion are favorable for the cultivation of a number of medicinal crops, such as valerian, hydrastis, etc.

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(b) The Cherepovets subregion of abundant moisture on the swampy low water divide plain. It is located in the former Cherepovets Okrug, with the exception of its southern part.

A region of increasing activity in industrial forestry and peat digging. Agricultural cultivation is very limited by the extent of the swampy forests, the great peat-bogs and the sandy soils, and has adapted itself to the unflooded valleys and ravines in the neighborhood of rivers and lakes, on medium and lightly podzolic loams and sandy loams.

The frost-free period lasts about 130 days, the total heat of the growing season is 1600-1800 degrees, the average temperature is about 17.5 degrees for July and minus 11.5 degrees for January.

Owing to the less industrial character of this subregion than in the case of subregion (a), vegetable growing is not as important. The cultivation of the cereals, winter rye and oats, is not under such heavy pressure, and they are able to survive in their former dominating role as forage crops. The possibility of growing malt barley is lessened by the shorter growing period and the local climatic conditions induced by the marshlands, though more favored locations here yield material of very high quality, which gives very good malt for brewing, where an adequate number of drying apparatus is provided. With the development of hog-breeding, barley could be promoted to the rank of a supplementary crop. The cultivation of peas should be encouraged in every way. It is not enough to ripen the early varieties of spring wheat, such as Novinka.

The possible assortment of forage crops and the possible varieties of grain are the same here as in the preceding region.

Flax growing and clover sowing, of the same importance as flax, can be developed as one of the primary crops, in the less marshy eastern part, with its loamy soils, as the southeast of the region is approached.

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II(8), The Luga-Pskov northwestern region of the zone of mixed forest, with its long growing season. It consists of the former Pskov Okrug, Luga Okrug, except for its northeastern part, and the southwestern part of Novgorod Okrug.

According to its soil characteristics, and partly as well according to the conditions of its thermal regime, the region is divided into : a northern part, (a) with a great preponderance of sandy soils, embracing the former Luga Okrug and the northwestern part of Pskov Okrug, and a warmer southern part, (b) of less uniform soil composition.

In comparison with all the previously discussed regions, this region enjoys the most favorable climatic conditions for agricultural cultivation. The proportion of marshland and of forested area is smaller. The frost-free period lasts 140-160 days, while the total heat of the growing season reaches 1800-2000 degrees. The relatively long summer is not hot, but since great cloudiness prevails during this season, the heat is very evenly distributed (the average July temperature is 17.0-17.5 degrees) and atmospheric humidity is high. The winter is warm, with average January temperature ranging from minus 8 to minus 9 degrees, though snowfall is relatively light.

All these factors combine to give exceptionally favorable circumstances for the expansion of high quality fiber flax culture, of sowings of malt barley, and also, given the favorable soil environment, for the advance of winter wheat into this region. The southern subregion is especially favorable, for while the podzolic clays are widely distributed, ranging from heavy loams to loam-sandy loams, and humus-limestone soils are also encountered.

In the northern subregion, soils of light sandy loam and sandy

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types are predominant, especially in its northern and western parts, and thus there is room for broad development of potato-growing for local consumption and for the neighboring Leningrad manufacturing area, as well as for expansion of forage production. Clover with additional sowings of rye represents an approach to fertilizing on poor sandy soils, and the late-maturing highly-productive varieties and silage crops should also be sown, such as sunflower, Jerusalem artichoke, legumes, etc. But in the south of the subregion, with the development of grass sowing even farther north, there are broad prospects for flax growing.

Thus, on the whole, of the various crops in the region, flax and the forages deserve the most attention. The combination of forage crops is the same as that given under II(7) for the neighboring Leningrad region, but here the importance of clover is particularly great in view of the larger areas of light mineralized soils and the necessity of building up their structure. More emphasis, on the other hand, should be placed on potatoes and lupine in regions with sandy soils. The longer growing period and the presence of sandy soils underline the possibility of using lupine for silage.

The primary grain crops are winter rye, malt and fodder barley, and oats. The growing season is long enough to make it possible to expand widely the sowings of peas. Winter wheat is now a secondary crop, but as it is adapted to favorable soils here, it should in time attain the status of a supplementary grain crop, as the general improvement of the fields proceeds and corresponding agrotechnical methods and winter-hardy varieties are introduced.

Attention must be given, too, to the introduction of horse-beans and forage peas. This is exceptionally important, not merely for agrotechnical reasons, but also to obtain concentrated protein feeds for

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dairy farming.

The following varieties should be planted: Vyatka winter rye; Professor Viner barley (Zolotoy is also admissible in the northern subregion); Zolotoy Dozhd oats (as supplemental varieties, Lokhovskiy for sandy soils, and Ligovo II for marshy soils); in the southern subregion, Moskovskiy A-0315 (Pobeda is admissible); Moskovskay 02411 winter wheat for sowing under the best conditions; Irlandetz (Irishman) and early varieties of Victoria type peas; the Perm¹ early-ripening selections beans (local varieties are admissible).

II(9), The Valday region of the central Russian elevation. This region includes the former Borovich Okrug, the eastern part of the former Novgorod Okrug and the southern part of Cherepovets Okrug.

This is a region of elevated rolling morainic terrain, with a northern belt of mixed forest. The dissected relief results in a wide range of climatic and soil conditions. The conditions of moisture, thermal regime, etc., depend on the elevation, the direction of the slopes, the mutual relations of the various topographic elements, etc. The range of soil cover in this typical moraine region is even broader, for in frequent and varied alternation coarse skeletal soils follow podzolic and weakly podzolic loams and sandy loams, heavy loams, oak soils and many swamps.

Summer precipitation is very abundant and snowfall is heavy. The frost-free period lasts about 130 days. The total heat during the growing season is 1800-1900 degrees, the average July temperature is about 17.5 degrees, and the average January temperature minus 10.0 degrees.

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These general climatic conditions, abundant moisture, considerable amount and uniform distribution of summer heat, call for almost the same selection of crops as in the preceding region.

There are extensive prospects for flax growing here, while soil and climatic conditions also guarantee better results from the forage crops than from grain cultivation, although the peculiarities of local variation in climate occasioned by northern slopes, damp lowlands, etc., must be taken into account in any consideration of the later forages; sunflower, Jerusalem artichoke, lupine and cabbage. The selection of forage crops is the same as that of the preceding region.

This diversity in conditions also compels us to omit malt barley, as a rule, from the list of supplementary grain crops, while the less exacting winter rye and oats retain their positions as primary grain crops. There are wide possibilities for expanding the sowings of peas and winter wheat in the southern part of the region as in the neighboring Pskov region.

The following varieties are recommended: Vyatka winter rye; Ligovo[#]II oats, (Lokhovskiy is admissible); Professor Viner barley, (the earlier variety Kol'khikum 10/30 is admissible); and Moskovskaya 02411 winter wheat.

Potatoes should be widely disseminated both to supply the industrial and population centers of the region, and to furnish succulent feed.

Thus, on the whole, Leningrad Oblast and Karelia may be divided into two basic areas: the northern industrial area and the southern flax growing area. The agricultural cultivation of the former is mainly specialized towards forage production, based on the improved pastures and hayfields, on sowings in the far north (II₁-II₃) of annual and

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perennial grasses, potatoes and root plants, and with a greater emphasis on clover and silage crops in the more southerly areas (II(4)-II(7)). The grain crops are of only incidental significance here, and to the extent that the stability of development of the primary forage crops is regulated by the need for supplying the local agricultural population, the productive and draft livestock of the region may be incidentally supplied with grains. In this same northern area, the field cultivation of vegetables assumes particular significance, especially in the Leningrad industrial region (II(7)), as does flax in certain localities of the south.

In the southern area, (II(8)-II(9)), flax and clover receive the greatest attention, shared as well by potatoes and a number of forage crops. The extent of grain cultivation is dictated by the same considerations, but we must grasp the opportunities for growing good malt barley, for substituting wheat for winter rye, and for obtaining a large quantity of proteins by increasing pea and bean sowings.

III. BELORUSSIAN SSR

The republic is situated in an exceptionally humid zone with a rather large amount of uniformly distributed heat and high atmospheric humidity. On the other hand, poor sandy loams and swampy soils predominate as a rule. These factors fix the basic pattern of agriculture as being devoted to animal husbandry, based on the wide opportunities of obtaining immense amounts of vegetative bulk.

The humidity of the climate and the thermal conditions also completely meet the requirements for the wide development of flax culture on the more cohesive soils in the north of the republic, and for potato

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growing on the sandy soils of the south, where hemp may also be grown if sufficient fertilizer is use. The long growing season and the uniform distribution of heat make this the best locality for malt barley and assure high yields for this crop, which is also essential for hog-breeding. All these crops can serve as bases for the development of the corresponding branches of industry and for the industrialization of agriculture. A very large variety of vegetable crops can be grown to supply the centers of population, as well as the regions of rapid growth in the woodworking industry. The republic's position on the state frontier facilitates transportation and increases the export possibilities for agricultural products.

The difference in thermal regime and soil cover divide the territory of the republic in two basic regions.

III(1), The north Belorussian region of peaty podzolic sand-loams and loams. It consists of the southwestern part of the zone of mixed forest (of pine and mixed forest containing a large proportion of deciduous species.). It includes the former Polotsk Okrug, Vitebsk Okrug, the northern half of Minsk Okrug, the northern part of Mogilev Okrug, and Orshansk Okrug.

This northern region of Belorussia, somewhat colder and with a greater variety of soils, is an extension of the adjoining southern region of Leningrad Oblast, (II(8b)), and is similar to it in natural conditions.

The frost-free period lasts 140-160 days. The total heat of the growing season is about 2100 degrees, the July average temperature is 17.00-18.5 degrees, and the average January temperature is about minus 7.5 degrees.

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The soils are mainly represented by peaty-podzolic sand-loams and sands, but loams occur in the north, the west and in the Minsk Rayon. There is a considerable amount of swamp area, most of it peat-bog.

The presence of cohesive soils, with the very high humidity of the climate, furthers the possibility of the wide development of flax culture and, on the other hand, also assures the expansion of forage cultivation.

The selection of forage crops is exceedingly rich. The hay crops are based on late and early red clover, and also use timothy, field peas, vetch mixtures, and West European type alfalfa. The root plants are selected for sowings, according to conditions and the economic situation, from among carrots, beets, and turnips (Brassica napus rapifera and Brassica campestris rapifera). In general, the importance of potato growing dominates over that of the root plants mentioned. In some places, especially on sandy soils, it assumes the position of a primary crop at the expense of flax culture. The following can be used for silage: sunflower, corn, field peas, lupine, buckwheat, horse-beans, sweetclover, Jerusalem artichokes, forage cabbage, and the aftermath of red clover. There is also a great available variety of succulent green fattening rations for grazing or for fresh forage to be fed during stall confinement. They include the following mixtures: rye and winter vetches, vetches and oats, vetches, peas and oats, vetches, peas, beans and oats, or field peas and oats, and also sweetclover, red clover alone or mixed with white clover, and, in the south, West European type alfalfa, corn, serradella, Jerusalem artichokes (for grazing), white mustard and winter turnips (Brassica rapa).

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The extensive distribution of light, sandy soils and the long growing season allow the expansion of potato growing to a very large acreage. This crop is cultivated here not only for forage but also, to a very considerable extent, for industrial purposes as well. The late industrial varieties allow free readjustment of sowing and harvesting dates.

In addition to its general mission of assuring a regular supply of locally produced cereals and concentrated feeds, in the form of rye, oats and barley, the grain culture of the region also has its special tasks. This region represents the largest and most dependable site for growing malt barley of the highest quality. This crop is also indispensable here for hog-breeding, now expanding on a base of potatoes; and it should be one of the primary grain crops. Attention should also be paid to strengthening pea cultivation, which enjoys favorable conditions. Beans, field peas, lupine, winter vetches and spring vetches should be included among the secondary crops which still have a very great general significance. These leguminous crops should be produced by the region on a scale sufficient to supply not only the local demand but to furnish as large a quantity of seed for tother regions as may be required.

In times to come, a considerable amount of winter rye can be displaced from these cohesive mineral soils by winter wheat, to which the mild conditions of the wintering period here are very suitable.

The following varieties are recommended: Vyatka rye; Professor Viner barley, (Zolotoy is admissible); Moskovskiy A-0315 oats as the basic variety, Ligovo II for dried marshland; (Zolotoy Dozhd' is admissible for use everywhere); Moskovskiy Q2400 and Moskovskiy Q2453 winter wheat are admissible, (Dyurabl is provisionally admissible).

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In the southern part of the region which is less suitable for flax culture, advantage should be taken of the favorable climatic conditions to expand the cultivation of hemp. The region is also very favorable for growing a long list of pharmaceutical and essential oil crops, namely: valerian, mint, hydrastis, gentian, lobelia, camomile and, especially, caraway.

There are wide possibilities of enriching the fields by planting the legumes lupine and serratella.

III(2), The sandy swampy south of Belorussia. It consists of western type mixed forest, predominantly pine but with a wide distribution of deciduous species including the white beech and has swampy forest areas. The former Bobruysk Okrug, Mozyr' Okrug and Gomel' Okrug, the southern part of Minsk Okrug and Mogilev Okrug excepting its southern part.

This region, with its very abundant moisture, is distinguished from the preceding region by the greater total heat of its growing season, which reaches 2100-2300 degrees, the longer frost-free period, 155 days and up to 170 days in the southwest, and the warmer winter though snowfall is scantier. But at the same time the soil conditions in the region are extremely unfavorable, for the soil cover is composed of a combination of sandy soils. The increase in the proportion of these soils as the south is approached is sharply expressed in the make-up of the crops. In the past, even the acreage under oats was cut in half in comparison with the north, at the same time that rye, as a crop used primarily for fertilizer sharply increased. A factor which considerably restricts the extension of the winter wheat areas is the greater prevalence of insect nests and of wheat mildew.

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In accordance with the soil and climatic conditions here, potato growing for forage and industrial uses should be widely developed. Among the special industrial crops, hemp is susceptible of wide expansion in sowings, if chemical fertilizers are more extensively applied and manures rationally utilized in localities of animal husbandry. Flax, however, can be cultivated only as a supplementary crop on the loamy soils in the north of the region.

The assortment of forage crops is the same as in the preceding region. Lupine for silage and serradella for hay should attain a greater importance.

As for grain cultivation, this remains principally a matter of winter rye, for the reasons indicated above. Obviously, this crop should here also be a cover crop for the perennial grasses, so as to bring the soils nearer to a fertilized condition, which is imperative with poor soils. Oats are a supplementary crop among the cereal group, while on the cohesive soils of the north, barley may similarly be grown as a supplementary crop. In the group of spring crops adaptable to poor soils, the grasses may be replaced by buckwheat, which, with respect to the climatic conditions, has here one of the most secure places in the USSR, and which can tolerate sandy soils.

But here as in the preceding region, special attention should be paid to the development of legume cultivation for consumption as well as for seed to supply this and other regions. Special attention should be paid in this connection to peas, lupine and spring vetches, and also to winter vetches, field peas, and beans.

In connection with the milder conditions during the winter, winter wheat has prospects of expansion on the more binding soils, if

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well fertilized, either as a crop immediately following plowing or as a second crop after plowing.

Except in the case of oats, no definitive selection of varieties for this region has yet been made. For rye, local mutants and a number of selections from ^(the)Petkusska ^(strain) give good results, as does the Vyatka variety. For oats the basic variety is Moskovskiy A-0315 and Lokhovskiy ~~is~~ for the drier, sandy soils, while Zoloty Dozhd' is admissible for all sites. For barley Professor Viner and Kol'khikun 10/30 are admissible. For winter wheat Moskovskaya 02411 and Moskovskaya 02453 are admissible.

Lupine and serradella are of very great significance as leguminous soil enrichers for this region.

Thus we see that the primary crops of Belorussia are flax, potatoes and hemp among the industrial crops, and a great assortment of forage crops, among which clover, potatoes and the silages are most important. Among the grain crops, malt barley, forage barley and a number of legumes play a role.

IV. THE WESTERN OBLAST

The economy of the Western (Zapadnaya) Oblast, like that of the Belorussian SSR, is developing in an agro-industrial direction. In the economics of the Oblast the dominating position belongs to agriculture. Within that agriculture, the intensive branches take the lead: flax culture, hemp culture, dairy farming and hog-breeding. The high population density and the shortage of land have long since forced the oblast into one of the leading positions within the entire non-chernozem belt with respect to its relative production of the non-cereal crops: flax, hemp, potatoes, and cultivated grasses. More than

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a third of the commercial flax in the USSR is produced here, as well as a seventh of the hemp. The oblast has more than 10 percent of the number of hogs in the SFSR, etc. In cereals it is a strongly deficit area. The necessity for expanding the forage bases demand the plowing of the less productive meadows, pastures and swamps, and increasing the productivity of the existing forage acreage.

The oblast is entirely situated in a zone where precipitation during the growing period is very abundant, and where, though winter precipitation is light, the winter is relatively warm. Summer heat in the forest zones is quantitatively very considerable, but is very uniformly distributed. However the growing season, if measured between the onset and the occurrence of frost, is considerably shorter here than in neighboring Belorussia. The ground cover varies in value, but in general the oblast possesses a very large amount of fertile soils in the form of loessy clays and loams which well repay the use of chemical fertilizers. The southern half of the oblast is seriously infested with insect nests.

The oblast is divided into the following four regions on the basis of climate, soils, surface feature, composition of cultivated vegetation:

IV(1), The Velikolutsk Lake - Marshland region of rolling morrains. It occupies all of the former Velikolutsk Okrug, except the northeastern part and consists of mixed forests containing a large proportion of deciduous species.

This region is distinguished from the other regions of the oblast by its longer frost-free period, which lasts here 140-160 days. The total heat of the growing season is about 2000 degrees. However, in

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connection with the high humidity of the climate, the average July temperature is approximately 17 degrees, while the average January temperature is about minus 8 degrees. Rubble loams and argillaceous sandy loams generally predominate in the soil cover, but sands, sandy loams, loams argillaceous soils, humus-loams, carbonate soils, swamp soils and alluvial soils, are all encountered and alternate in varied patterns. There are many swamps in the basin of the Lovat' and Polist'.

The character of the climate and, in places, of the soils, encourage the cultivation of a wide range of crops, including flax, wheat and malt barley. Conditions are not quite so favorable to flax culture as in the neighboring Pskov flax region, on account of the somewhat more continental character of the climate and the greater variety in the soils, but, nonetheless, it is the leading crop in the region. On the other hand, the considerable extent of forage lands lends great importance to animal husbandry and to forage production. The latter should base itself on the expansion of sowings of late and early red clover with timothy and vetch-oats mixtures. There is a wide variety of possible combinations to obtain other forms of bulky forage. For succulent and green fattening rations the following should be sown: mixtures of rye with winter vetches and of oats, vetches and peas, with the addition of horse-beans, late and early red clover, and, on more sandy soils, field peas, serradella, and Jerusalem artichoke. Economic and natural conditions in the region make it advisable to use winter rape (B. napus), white mustard and sweetclover. For silage there may be grown sunflower, corn, horse-beans, buckwheat, vetch-oat mixtures, clover, Jerusalem artichoke, forage cabbage, clover aftermath and sweetclover. Of the root crops, potatoes, beets, carrots and turnips (Brassica napus rapifera and Brassica campestris rapifera) may be introduced, depending on the requirements and the circumstances of the individual enterprises.

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Potatoes, besides being used for human consumption and forage, can also have great importance for industrial purposes, especially in localities with large amounts of sandy soils. They can sometimes occupy the position of a supplementary crop and in some places be a primary crop.

With the development of the sowings of grasses, flax and potatoes, the cereal crops should become relatively less important here, and certain rearrangements in their make-up are necessary. Forage barley and malt barley production should be raised to the level of winter rye and oats, the primary grain crops of this region inasmuch as they are assured here of very favorable conditions, both in relation to consistently high yields and to high quality. Winter wheat should be widely cultivated in areas with loam and argillaceous soils, which give yields of winter wheat not inferior to those of rye. Finally the following legumes should be raised to the status of supplementary crops: on sandy soils, peas and spring vetches for seed, and on argillaceous soils horse-beans, the latter group, besides satisfying the demand of the region itself, can also have definite functions in producing seed for the neighboring regions to the north and east. There are places in the region with loamy "wheat" soils, where very good results are obtained with spring wheat, and until the supply of outside wheat is completely readjusted, this crop may maintain a certain secondary rank, though not at the expense of the expansion of flax culture on better soils.

The following varieties may be grown: Vyatka winter rye; Moskovskaya 02411 winter wheat; Moskovskiy A-0315 oats, Pobeda and Leytevit'skiy-Engel'gardtovskiy admissible; Professor Viner barley,

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Zolotoy admissible.

IV(2), The highland water divide between the Volga, Dnepr and Western Dvina of abundant moisture. It includes the northwestern part of the former Velikoluts'k Okrug, the former Rzhev Okrug, the northern part of the former Smolensk Okrug, and the northern part of Vyazemsk Okrug.

It includes relatively compact mixed evergreen-deciduous forests. The frost-free period is considerably shorter than in the previous region, lasting 130 - 140 days. The total heat of the growing season reaches 2000 degrees only in the south. The average July temperature is 17-18 degrees, and the average January temperature is minus 8.5 to minus 9.5 degrees. The region is thus distinguished, in general, by a colder and more continental climate than found in preceding regions. Abundant precipitation during the summer months strongly regulates the thermal regime in the direction of even progression, and assures a high moisture content in the air, and in the soil, thereby creating very favorable conditions for flax.

The markedly lower proportion of marsh land and the dominance of fertile loessy loams in the soil cover also favor flax culture, although, together with these loams, there are to be found less valuable sandy soils, podzolic sand-loams, podzols, as well as marshland in the northwest. The region is one of intensive cultivation and should become especially intensive in flax culture. Only the northernmost, undulating lake area, where the Volga and Dvina rise, with its great proportion of swampy-sandy soils is less valuable for agriculture than the west, where alongside of flax culture, forage production should play a more important role.

The assortment of forage crops is in general the same as in the preceding region. However, in connection with the shorter growing

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period and the smaller amount of heat, corn for silage is more promising in the southern part of the region, while field peas and white mustard are more worth while for the north.

On account of the intensification of animal husbandry and the possibility of industrial uses for potatoes, the latter rise to the level of supplementary crop in localities with extensive tracts of light sandy soils.

In connection with the fact that the region has a great deficit in cereals and concentrated feeds, the grain crops, though reduced in relative importance, should still, on the whole, be very important as incidental components in crop rotations, though not at the expense of the primary crops. But this should only be done if the grains are transferred to parts of the region having poorer soils which are less suitable for flax culture. Winter rye and oats will remain the principal grain crops. Sowings of two-row malt barley afford less promise of high quality. Nevertheless, it is perfectly possible, in localities assuring early sowings, fertile plots, etc., to take advantage of the uniform humidity of the climate to obtain very good brewing material. Taking into account the importance of barley for hog-breeding, which is expanding in the region, it is necessary to fix its scale of production as that of a supplementary crop in the grain group. Winter wheat is also potentially able to supplant winter rye to a very great extent here. Attention must also be paid to the expansion of pea and horse-bean sowings, and, on the sandy soils in the south of the region, of spring vetches.

The varieties of grain are the same as for the preceding region. For conditions demanding greater rapidity of maturation, Kol'khikum 10/30 variety of barley is admissible instead of Zolotoy.

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IV(3), The warm Smolensk region of loamy soils and abundant moisture.

It includes the southern part of former Smolensk Okrug, the southern part of the Vyazma Okrug, the northern part of Roslavl' Okrug and the northern part of Sukhinichi Okrug. Mixed evergreen-deciduous forest, with large proportion of deciduous species, comprise the chief vegetation.

The frost-free period here is 130-140 days, but because of the higher mean daily temperatures in autumn, the growing period is longer than in the preceding region, and it has a total heat of 2000-2100 degrees. The average July temperature is 17.5-18.5 degrees, and the average January temperature is minus 9 degrees. The snowfall is considerable, the mean maximum depth being 40-45 centimeters; and winter is thus very favorable for the wintering period of grains. Summer precipitation is very high. From May to July it reaches 225 millimeters and higher.

The place of swamps in the composition of the soil cover is negligible. In it predominate podzolic loams and argillaceous sand-loams on relatively uniform rubble clays or their parent clays or loess clays. There are also alluvial flood-plain soils along the Dnepr and other rivers. The region is thus not less favorable than the preceding region for flax culture and the intensive development of animal husbandry, and besides this the existence of flood meadows greatly increases the relative importance of animal husbandry.

The selection of forage, industrial and grain crops is the same as in the preceding region, but since this region is densely populated, there is more emphasis on forage production than in the livestock sections of the latter. Forage crops here include potatoes and root crops, silage crops, green fattening feeds and cultivated grasses.

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The position of barley and spring wheat in the group of cereal crops should be strengthened. Very high grade barley can be produced in the west of the region. The varieties of cereal crops are the same as in the preceding region.

The existence of the important industrial centers of Yartsevo and Smolensk in the region calls for the organization of vegetable growing, for which a very large selection of crops and varieties is available.

IV(4), The Klintsey-Bryansk region of sandy soils and abundant moisture.

It is composed of the southern part of the former Sukhinichi Okrug, the southern part of Roslavl' Okrug, Bryansk Okrug and Klintsey Okrug. This is a transitional belt of mixed forests, with pines predominating, towards pine forests on sandy soil and broad-leaved groves.

The frost-free period is 130-140 days, but there are many more warm days with high mean daily temperatures than in the preceding regions of the oblast. In exactly the same way the total heat of the growing season is increased here to 2000-2200 degrees. The mean temperature for July is about 19 degrees, and for January ranges from minus 8.5 to minus 11.0 degrees, indicating a more continental character of the climate than in the preceding northern regions, in spite of the fact that moisture here is so abundant. Nevertheless, wintering conditions are relatively mild. The soil cover is composed predominantly of sandy and peat-podzolic sandy loam soils, with infrequent occurrence in the southeastern part of the region of weakly podzolic loams and degraded, leached soils of chernozem type. Alluvial flood-plain soils are distributed along the river valleys.

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The region is strongly infested with harmful insects. As far as soil and climate, are concerned, the southwestern part of the region (IV(4a), embracing the former Klintsy Okrug) is included in the zone of western type mixed forests, and conditions are very similar to those in the sandy-swampy region of Belorussia (III(2)). The selection of crops and varieties should therefore be identical with that for the latter livestock region, with primary weight assigned to forage, potato and hemp production, to strengthening the position of the leguminous crops among the grains, and expansion of vegetable growing near the manufacturing centers of Klintsy, Novozybkov and Syrazh.

The rest of the region, however, differs somewhat in crop composition from the south of Belorussia.

The wide distribution of sandy loam type soils and the relatively high summer temperatures exert a strong influence on the yield and quality of fiber flax. The only part of the region that affords any future possibility for the advance of long-fiber flax culture, and that only after rational organization of agricultural cultivation, is the northern^h most humid section, comprising the northeastern part of the former Klintsy Okrug, the northern part of Bryansk Okrug, the southern part of Roslavl' Okrug and the southern part of Sukhinichi Okrug. At the same time the region does offer favorable conditions, especially in its southeastern part, for the intensive development of hemp culture and potato growing for industrial uses, human consumption, and forage.

The cultivation of tobacco for cigars should attain great importance in the region, especially under the more favorable conditions of Pogarskiy and Pochepskiy Rayons.

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The selection of hay crops and tuber crops is the same as in the preceding region. Sunflower, corn, horse-beans, vetch-oat mixtures, clover, Jerusalem artichoke, forage cabbage, buckwheat and sweetclover may be successfully employed for silage. The same crops should be used as succulent green fattening feeds as those mentioned for this purpose under the preceding regions of the oblast, with the addition of Ukrainian alfalfa and Grimm's alfalfa.

The greater number of population centers, which gives this region of the oblast a more significant industrial character, calls for the wide organization of vegetable growing and fresh milk dairying.

Spring wheat and barley are unpromising on account of the poor sandy soils, which require frequent fertilizing, and the prevalence of insect pests. In the south of the region even the yield of oats is appreciably lower. Winter rye, using fertilizer, is the most dependable all-^{around} cereal. Winter wheat does not thrive on light sandy soils, but can come to occupy a firm position on the various chernozems of the Southeast. Thus, of the grain crops, winter rye (Vyatka variety) is primary. Oats are a supplementary grain crop. Moskovskiy A-0315 is the basic variety; supplementary varieties include, for lighter sandy soils, Lokhovskiy, and for the chernozem-type soils of the southeast, Shatilovskiy-056. Barley can be sown on the scale of a secondary grain crop on the more ^{cohesive} binding soils in the north of the region, using the more productive variety Professor Viner and the Swedish-fly resistant forage and groats variety Kol'khikum 10/30. Conditions for buckwheat are entirely favorable, and it can also be grown as a secondary crop. The following leguminous crops each occupy relatively small areas, but should be of very great collective importance: peas, small-kernel lentils, spring and winter vetches, and lupine and serradella should

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in practice be accompanied with the wide application of mineral fertilizers, especially after hemp.

On the whole, then, the natural conditions and the character of industrial development in Zapadnaya Oblast determine its agricultural pattern to be: cultivation of flax, forage, hemp and vegetables, together with grain (rye and legumes).

V. MOSCOW OBLAST

The central location of the oblast and its highly elongated north-south configuration cause its several parts, to include both a forest zone of evergreen, mixed and deciduous trees, as well as a zone of wooded steppe. The northwestern part of the oblast is included in the zone of abundant moisture, while moisture in the southeastern part is only moderate. Accordingly, thermal conditions in general diverge widely as one proceeds from northwest to southeast, and there may be differences as high as 500 degrees in the total heat of localities situated on such northwest-southeast lines. The structure of the land surface and the composition of the soil cover similarly show extremely great variations between the elevated moraine strata of podzols and sands in the northwest and center and the low-lying plains of fertile grey loams and chernozem soils in the south.

The strong development of industry and the convergence of numerous railroad lines in the central part of the oblast sharply distinguish it from the less cultivated, less reclaimed north, on the one hand, and the more agricultural south, on the other.

The combination of all these conditions provides a very diversified background for the large number of possible combinations in organizing agriculture. With respect to the selection of crops and varieties for cultivation, to the extent to which such selection, while

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preserving its well-known fundamental plasticity, is susceptible of determination by the principal economic and natural factors, the oblast may be divided into the following four regions, each of which is extended into the adjoining oblasts.

V(1). The relatively colder Tver'-Ves'egon region of diversified soils and abundant moisture. It includes the former Beshitsa, Tver' and Kimry Okrugs, [†] a transitional zone of evergreen and mixed forest.

The frost-free period is only about 130 days, while the total heat of the growing season is 1800-1900 degrees. The average temperature is 17.5 to 18.5 degrees for July, and minus 10.5 to minus 11.5 degrees for January.

There is considerable diversity in the soil cover, corresponding to the high rolling relief, with marked evidences of glacial action. Peat-podzolic loams predominate in general, mainly superimposed on rubble-clays, but peat-podzolic sand-loams are also widespread, while podzols are also encountered, as well as occasional sands along the rivers. There are relatively few swamps, but the exceedingly large-scale peat deposits on the left bank of the Volga are of great interest for exploitation as fuel.

The sandy soils in the southwestern part of the region are an important focus for the ^{intensive spreading} dissemination of winter cutworm moth infestation.

The large Kalinin Textile Center is located in the region, and there are great prospects for the development of flax processing and related industries.

Abundant precipitation and a moderate amount of heat, and a widespread distribution of loamy soils, places the development of flax culture in the first rank, inasmuch as flax here yields a fiber of high quality.

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Dairy farming and hog-breeding, based on intensive forage production, is a subordinate branch of agriculture, but has considerable prospects.

Late red clover, which is a constant companion of fiber flax, for use together with timothy and vetch-oat mixtures, is recommended as a basic hay crop. Sunflower, horse-beans, sweetclover, vetch-oat mixtures, clover, buckwheat, and Jerusalem artichokes may be sown for silage, with corn added in the more promising locations. If the root crops, depending on natural and economic circumstances in the various localities, the following may be sown: potatoes, turnips (*Brassica napus rapifera* and *Brassica campestris rapifera*), beets and carrots. The supply of succulent green fattening feeds may be assured by sowing rye and winter vetch mixtures, vetch-oat mixtures, late and early red clover, sweetclover, white mustard, winter rape and on sandy soils, serradella.

The considerable amount of sandy soil along the Volga, Medveditsa, Mologa and other rivers, which is not particularly suitable for fiber flax culture, can be utilized for the wide expansion of potato growing, not merely for human consumption and forage, but for industrial uses as well.

Of the grain crops, winter rye and oats retain their place as primary crops. The varieties include: Vyatka rye and Ligovo II as the basic variety of oats, because it is a moisture-loving and very early variety and yields high quality grain.

The best land with loamy soils for spring crops may be very successfully sown with two-row barley of the Professor Viner variety (but not at the expense of flax). This not only yields good groats and

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forage, but if proper drying is assured, it gives very superior malt barley as well. If desired, spring wheat can also be sown as a subordinate, secondary crop, under more assured soil conditions. Special attention should be paid to expanding the sowing of peas for forage and human consumption, and also to the cultivation of horse-beans. The region around Kalinin requires a wide organization of vegetable growing. It is not superfluous to repeat that, as in a number of preceding regions of the abundant-moisture zone, the success of agricultural cultivation depends to an immense degree on the proper organization of crop-drying and the intensification of harvesting operations through mechanization.

V₍₂₎, The moist Moscow-Kaluga region of loamy soils. It includes the former Moscow Okrug, the former Kaluga Okrug, the northern parts of Serpukhov Okrug, and Kolomna^a Okrug, and the northwestern part of Tula Okrug and consists of evergreen-deciduous forests, changing in the south to large isolated tracts of ^{broad} ~~bleed~~-leaf forests and oak groves.

The frost-free period is about 135 days. The average July temperature is 18 - 19 degrees and the average January temperature is minus 10 to minus 12 degrees. As in the preceding zone, snowfall is relatively high, the average maximum depth of snow cover being 45 to 50 centimeters. The growing period is characterized by higher precipitation and higher atmospheric humidity in the northwestern part of the region than in the southeastern section.

In the low hillocks there is a great predominance of podzolic loams based on relatively uniform rubble-clay or on the products of their weathering (structured clays of loess type). In the south there are, in places, forest loams and isolated areas of northern varieties of chernozems.

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There are several very large industrial centers in the region, and the construction of power plants using coal of the Lower Moscow basin is being energetically pushed. Even now, the selection of crops for cultivation has already come under the powerful influence of the industrial character of the region, which is strongly stimulating agriculture here.

The relative importance of vegetable growing in the immediate vicinity of the population centers is rapidly increasing^g as is that of forage cultivation to supply the expanding fresh-milk dairy industries located at a somewhat greater distance. The role of cereal cultivation is directed to meet the local demand by supplying grain for consumption by the rural population and concentrated feeds for the cattle. For this purpose it must utilize field space and soil fertility left over by or from the primary crops. Accordingly the percentage of fallow and of winter rye is reduced. Thus, for the immediate future, oats will remain in a position higher than that of rye, though in general its relative importance is declining, because they are indispensable here to improve the rations of the immense number of horses in this industrial region, which is one of the best in the USSR in quantity and reliability of the oat harvest. Potatoes for human consumption is one of the most important primary crops, to a lesser extent^g for industrial use and to a very great extent as a succulent winter feed for dairy cattle and hogs.

In the northwestern part of the region, which enjoys abundant moisture, primarily west of Volokolamsk, advantage should be taken of the opportunities for improving flax production provided by climate, soils and the great prospects for mechanization; in this ^{region} part, flax should play the role of a leading crop.

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Depending on the tendencies of economic organization and the peculiarities of the natural conditions in different parts of the region, forage crops can in general be selected out of the following list: for hay, late red clover with timothy and vetch-oat mixtures; for root crops, beets, potatoes, turnips (Brassica napus rapifera and Brassica campestris rapifera) and carrots; for silage, sunflower, corn, horse-beans, sweetclover, vetch-oat mixtures, clover, buckwheat, Jerusalem artichokes, and forage cabbage; and for succulent green fattening crops, rye and winter vetch mixtures, vetch-oat mixtures, late and early red clover, sweetclover, white mustard, winter rape; and for sandy soils, serradella.

Among the cereals the primary place is here occupied by the less exacting oats. In view of the high quality of local seed, only one basic variety is recommended, namely Moskovskiy A-0315, which is distinguished by its higher and more consistent productivity as well as by the especially high quality of the grain. Winter rye (Vyatka variety), is less important than oats. The cultivation of barley and spring wheat is unpromising here on account of the Swedish fly, and other reasons which have as yet been insufficiently clarified. Nevertheless, if the need arises, sowings of these crops in the north of the region can be increased, especially if cultivated crops are sowed as a predecessor, and especially if the Professor Viner variety of barley is sown. Winter wheat is very promising and should be widely extended everywhere, displacing rye. Moskovskaya 02411 may be used. Particular attention should also be given to expanding sowings of the legumes, especially peas and horse-beans; with small seed forage lentils for sowing on the sand-loams of the south.

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Conditions in the region are favorable for developing a base for the production of medicinals for supplying the chemical-pharmaceutical industry with lobelia, camomile, valerian, hydrastis, gentian, tangut, rhubarb, and scopolia.

Makhorka tobacco can be grown as a secondary crop in the south of the region.

V(3)' The Klyaz'ma-Oka moderately moist massif of sand accumulations.

The long, narrow shape of the region, stretching^g as it does from northwest to southeast, forces its division, along the Oka River, into two parts: (a) an area of mixed evergreen-deciduous forest, predominantly pine, which includes the extreme southeastern part of the former Moscow Okrug, the northeastern part of Kolomna Okrug, Orekhovo-Zuyevo Okrug, and the northern left-bank part of Ryazan' Okrug. (b) A belt of pine woods on sandy soil, passing over into wooded steppe, on the sandy soils along the Tsna River, which includes the eastern part of the former Ryazan' Okrug. The frost-free period is 130-140 days, the total heat of the growing season is 2100 - 2200 degrees, the average July temperatures range from 18.5 to 19.5 degrees and the average January temperature is about minus 11.5 degrees. Precipitation during the growing season is less assured here than anywhere else in the ^{region} oblast, and snowfall in the winter is relatively heavy.

The southeastern wooded steppe subregion (b) on the Tsna River is distinguished from the rest of the region by its greater dryness and the greater heat of its growing season.

In the soil cover there is an exceptional preponderance of sand loams, pine wood sands and other sands. The relief of the low-lying terrain is swampy. Along the Oka, Tsna and other rivers there

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are alluvial soils on extensive flood-plains.

Insect infestation is considerable, especially that of the Swedish fly.

The presence of industrial centers and the development of super-power stations burning peat demands the establishment of mass vegetable growing. The region is also fundamentally one of dairy farming based on the flood meadows and on forage production on cultivated lands.

In connection with the widespread distribution of sandy soils, potatoes attain the position of one of the primary crops. They are grown for industrial uses, for human consumption in the large centers of population, and as forage for dairy cattle.

The more continental character of the climate, the greater dryness and the higher temperatures of summer, as well as the wide distribution of sandy soils, draw the boundary here for the further propagation of fiber flax. Semi-fiber flax, however, can still be cultivated here and there in the region, if desired, on the scale of a secondary crop. Moreover, a rust-resistant fiber flax, for instance of the Shatilovskiy D-83 variety, has distinct possibilities for future use.

The composition of forage crops is the same here as in the preceding region, but with a greater use of potatoes, corn and serradella. Nitrogenous enrichment of the soil by lupine sowings is very important.

Winter rye has first place among the grain crops suitable for the poor sandy loam soils of the region, in connection with the necessity for frequent use of fertilizer, and also with the partial fertilizing achieved by sowing forage grasses. (As additional sowings after the fertilized winter crops.) Vyatka variety may be used in

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subregion (a); Vyatka and Shatilovskaya are admissible for subregion (b). Oats retain their place near that of rye as a supplementary crop, although in consequence of the sharply lower rainfall here and the great permeability of the sandy soils, this moisture-loving plant gives considerably more unsatisfactory results in productivity and in reliability. The Moskovskiy A-0315 variety may be used. Barley, spring wheat and winter wheat are unpromising. The groat crops buckwheat and proso millet may be grown, with the former on the scale of secondary crops. Particular attention should be paid to the expansion of the sowings of peas and small-seed lentils, which besides being useful here for human consumption and for age, also supply seed and possess immense agrotechnical significance.

V(4), The Tula wooded steppe on northern varieties of chernozem. The southern parts of the former Kolomna Okrug and of Serpukhov Okrug, together with the southeastern part of Tula Okrug and the southwestern part of the former Ryazan' Okrug. It is a transitional belt between broad-leaved forests and oak groves and the northern wooded steppe with variegated grasses.

As a result of the somewhat more continental character of the climate, the frost-free period is no longer here than in the two preceding regions, in spite of the more southern location of this region. It is 130-135 days. Similarly, with the total heat, which is 2100 to 2200 degrees. The average July temperature is 18.5 to 19.5 degrees, and the average January temperature is about minus 10 degrees. While average humidity is moderate, western parts of the region enjoy abundant precipitation during the growing season (up to 200 millimeters),

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and in the east it is also strong (up to 150 millimeters). Snowfall is relatively heavy during the winter, the mean maximum depth of the snow cover ranging from 40 to 45 centimeters.

The soil cover is composed of degraded, leached chernozems, dark gray wooded steppe loams and gray forest loams. The Swedish fly is very prevalent.

Since this is a transitional region, it offers entirely favorable conditions to a series of cereals and industrial crops, and, at the same time, to intensive forage production. In the absence of significant amounts of natural forage lands, and in view of the large production. In the absence of significant amounts of natural forage lands, and in view of the large population and the high proportion of cultivated land, the role of grains stands out more decidedly in comparison to that of forages.

The cultivation of spring wheat and barley is sharply restricted by the considerable infestation with the Swedish fly and a number of other causes, as yet unclarified. Among the grains, winter rye and oats maintain their leading position. Vyatka and Shatilovskaya are admissible varieties of winter rye. Moskovskiy A-0315 may be sown for oats, while Shatilovskiy 056 is a supplementary variety. With the development of large-scale enterprises and kolkhozes, it would be possible to strengthen the cultivation of winter wheat, which has almost vanished with the liquidation of the old landowner agricultural economy. Varieties are Khar'kovskaya 0917 and, provisionally, Dyurabl'. Among the secondary crops, those which enjoy the most promising conditions for expansion are the groats: buckwheat and proso millet, as well as peas and small-seed lentils. These latter

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deserve particular attention.

Together with their importance in human nutrition and animal feeding, potatoes also take the role of a primary crop in the group of industrial crops. Among the textile fiber and oil crops, hemp here ranks as a supplementary crop, while semi-fiber flax may be grown, if needed, as a secondary crop - together possibly with the rust-resistant long fiber flax variety Shatilovskiy D-83. Although hemp culture here is not assured of the highest qualities of fiber, it does yield consistently good crops. The qualities of the soils and the very dry harvesting season in the southeastern part of the region make safe cultivation of makhorka tobacco entirely feasible.

The selection of forage crops is the same as in the two preceding regions of this oblast.

The agricultural cultivation of Moscow Oblast may thus, in the main, be specialized in separate parts in flax, vegetables and potatoes, and in a series of industrial crops, and also, in the southern part, in cereal and leguminous crops as well.

VI. THE INDUSTRIAL IVANOV OBLAST

The growth of large-scale industrial manufacturing and the accelerated growth of the industrial population have abruptly shifted the former half-primitive character of the agriculture of this oblast in the direction of correlating its productivity with industry in the major fields of specialization of the latter: namely, the flax industry, with flax culture and the cotton goods and food industries, through the use of starch with potato growing, ^{and} strengthening the position of barley etc. The development of a large market for food has confronted the local agricultural economy first of all with a demand for perishable

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food products: vegetables, berries, fresh milk and other dairy products, and thus has stimulated vegetable growing and forage production. The ~~waste~~ from the sharply expanding potato growing, vegetable gardening, and dairy farming assure the possibility of a broad expansion of hog-breeding, while the existence of circumstances allowing the utilization of the valuable Romanov sheep focus the attention also on the sheep-raising for sheepskin jackets. Natural conditions in the oblast encourage in every way the development of these branches of agriculture; and this development has already called forth the organization of special regions, such as the Yaroslav, Moscow and Gorbatovo dairy cattle regions, the Romanov sheep region, the Myshkin flax region, the Rostov pea and chicory region, the Vyatka and Vязnikov cucumber regions, the Pogorel' and Vladimir cabbage regions, the Lukh, Suzdal' and Mster onion regions, etc. At the present time there are a number of rayons with as much as 20 percent of their total cultivated acreage under flax, and as much as 25 percent under potatoes.

With rare exceptions, conditions in the oblast are less suitable for the grain crops. Nevertheless, in different localities, by reason of specific natural conditions or extreme lack of roads and consequent difficulties of ~~moving outside~~ ^{transporting} grain and concentrated feeds, there is no choice but to give the problem of local cereal cultivation a very considerable amount of attention.

With respect to the selection of crops and varieties and the possibilities of their successful cultivation, the oblast can be divided, basically, into the following five regions.

VI₍₁₎ The Mologa-Sheksnia flood-plain meadow region. It includes the northern parts of the former Rybinsk Okrug and of Yaroslavl' Okrug and consists of southern pine forest of western type. There is wide distribution of vegetation on flood meadows and dry bottomland meadows.

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The frost-free period lasts 120 to 130 days, and the total heat of the growing season is about 1800 degrees. Summer rainfall is high: 175 to 200 millimeters for May-July, but less than in the adjoining western region of the oblast (IV₍₃₎). The average July temperature is 18.0 to 18.5 degrees, and the average January temperature is from minus 10.0 to minus 12.5 degrees.

The ground cover of the very moderately rolling water divides is represented primarily by peaty-podzolic loams and argillaceous sandy loams, based on boulder sands and other sandy soils, and in the north by occasionally compact clays. Along the rivers there are belts of sandy loams, sandy and swamp soils underlain by alluvial deposits. In the west, extensive stretches of peat-bogs are encountered. There are broad belts of alluvial soils in the river valleys.

The rich flood plains of the Volga, Sheksna and Mologa rivers are a valuable resource of the region, assuring as they do a very large supply of forage and in particular affording a suitable basis for the development of seed growing of meadow grasses. But the argillaceous soils of the water divides, in conjunction with the humid, moderately warm climate, are of no less value to agriculture for the development of flax culture. Already large-scale flax sovkhozes (Lyubimskiy and Poshekhon'ye-Volodarskiy) have been established. The fundamental orientation of the agricultural cultivation of the region has been determined with the creation of special large-scale vegetable and potato growing areas below Rybinsk and Yaroslavl', for the entire region in the direction of forage production and the development of dairy farming, and flax culture for the northeastern part of the region.

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The choice of forage crops can vary sharply according to the character of the land: active or exhausted flood-plain, plowed forest or swamp water divides, etc. In general, their composition consists of a large choice of grasses: late red clover, with timothy and vetch-oat mixtures for hay; sunflower, horse-beans, sweetclover, vetch-oat mixtures, clover, buckwheat, Jerusalem artichoke, and forage cabbage, with corn under optimum conditions for silage; beets, potatoes, carrots and turnips (Brassica campestris rapifera) as root crops; rye-winter vetch mixtures, rye-oat mixtures, early and late red clover, sweetclover, white mustard, winter rape, and, for sandy soils, serradella for succulent green fattening rations.

Potatoes, besides their immense importance for human and animal consumption, have also a very great importance for industrial purposes, and thus should be a primary crop here not merely in regions of sand loam and sandy soils but occasionally even on loamy soils. With reference to that part of the crop destined for industrial processing, in view of the considerably shorter growing season, earlier varieties, than those usually grown, must be selected from the factory grades of potatoes for starch.

The grain crops here are of subordinate importance; oats and winter rye as the less demanding crops should be cultivated as primary crops among this subordinate group. The varieties should consist of Vyatka winter rye and Ligoro II oats, with possible use of Pobeda. Barley should also have an important position here for use in concentrated feeds and for making good groats. Where desired, on more favorable sites and on properly equipped farms, it will also yield excellent malting barley. The main variety should be Professor Viner, while for conditions requiring greater rapidity of maturation, Kol'khikum 10/30 is admissible. Another reason for paying attention to barley

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growing here is that with the exception of the following regions, (VI₍₂₎ and VI₍₃₎), barley and winter rye are so subject to damage by insects in the regions of the oblast that they can hardly be cultivated on a significant scale. Sowings of winter wheat and the early varieties of spring wheat can be expanded on loamy soils which are not water-logged. Special attention must be devoted to the expansion of pea and bean sowings, which are valuable not only for human consumption but also for concentrated feed for dairy cattle.

VI₍₂₎, The Unsha-Kostroma water divide region with its short growing season. It includes the former Kostroma Okrug and the central and northern parts of the former Kineshna Okrug. This is a transitional region between eastern and western type evergreen and mixed forest.

The frost-free period is about 115 days, but the total heat of the growing season is about 1800 degrees, and the average July temperature is 18.5 degrees. The average January temperature ranges from minus 12.5 to minus 13.5 degrees. There is heavy snowfall in winter, and the mean maximum depth of the snow cover is about 55 centimeters. The summer rainfall is relatively heavy.

The region is located in a belt of early autumn cold and late spring floods, a pattern which travels along a clearly defined course from the ridge of the Urals towards Poles'ye. At the same time the region serves as a sharp transition, with respect to ^{the} continental character of climate and thermal ^{range} regime, between the east and west of the European part of the north, for it is here that, during the summer months, the isothermal lines from the east abruptly change their course along the parallels of latitude and veer to the southwest, while during the winter

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months they veer to the east from the ^{NE}~~SE~~ northward course along the meridians.

The soil cover is predominantly composed of peat-podzolic loams and argillaceous soils, based on underlying heavy cover loam. Typical podzols are encountered, while sandy and sandy loam soils are wide-spread. Alluvial soils are to be found in the river valleys. There are relatively few swamps, and many forests of high quality timber. This is the least thickly settled and least cultivated region of the ^{region}~~object~~, with a rapidly expanding lumbering industry.

The northeastern part of the region must be separated from the rest of it, and set up as a separate subregion VI_(2a). This is the most heavily forested part, and, situated for the most part on sandy and bog soils, it is distinguished by a somewhat shorter growing period and a lesser amount of moisture. In contrast to the other parts of the region, this subregion contains elements of the Siberian taiga forests, including the Siberian deciduous flora. The selection of field crops should be strongly influence by the heavily forested nature of the subregion, as well as by the character of its soil cover, and still more significantly by the considerable ^{lack of roads}~~degree of roadlessness~~ and isolation. Forage and vegetable cultivation ^{are} becoming important for the population engaged in lumbering and for draft animals, as well as forage for the dairy cattle, grains for the consumption of the local population, and also potatoes in localities with relatively good transportation and light soils, as well as a possible development of flax cultivation in places with the more ^{cohesive}~~binding~~ soils.

In general the whole region can be specialized primarily along the lines of flax cultivation and dairy farming, with butter and cheese being produced in the northern parts and fresh milk, together with fer-

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mented milk products, in the south, where, on account of the existence of a number of large scale manufacturing centers, vegetable growing is also developing. In the northeastern subregion the very widespread distribution of sandy and marshy soils and of forests affords considerable prospects for potato and forage cultivation.

Difficult transportation conditions increase the significance of grain cultivation for human and animal consumption. Forest clearings can be used and livestock-grain sovkhozes organized to furnish forage in the area of lumbering enterprises, provisions for the local population and concentrated feeds for the dairy cattle and hogs until the supply of outside grain arrives more freely.

Potatoes for animal and human consumption are very important in all parts of the region, and, in the southern part, for industrial uses as well. This crop should thus be one of the primary crops. Since the growing period is distinctly shorter and the harvesting of large quantities of potatoes would be difficult during the bad weather of early autumn, it is essential to select the early industrial varieties.

The strengthening of the forage resources of the improved hayfields and pastures of this region may proceed, in general, with the same crops as in the preceding region, depending on the economic and natural conditions from place to place, but with less use of corn for silage and greater use of potatoes and turnips in the tuber group.

In the cereal group, winter rye and oats are most promising, the varieties to consist of Vyatka winter rye and Lokhovskiy oats for lighter sandy soils with Moskovskiy A-0315 being admissible for the more ^{cohesive} binding soils. Barley is protected by the climatic conditions

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from the spread of the insect pests of the region, and can be raised to the place of a supplementary crop. It is important here as a valuable feed for hogs and for preparing good groats, as well as for malting where circumstances permit. The varieties consist of Professor Viner and the earlier Kol'khikum 10/30. The earlier varieties of spring wheat may, if desired, be grown on suitably located, more structured, loamy soils that are not waterlogged, on an increased scale, but still only as a secondary grain crop. The culture of field peas and peas for human consumption should be particularly stimulated, as conditions in this region, especially in its southeastern part, are ideal for these crops.

VI₍₃₎, The Myshkin flax growing region of abundant moisture. It includes the southern part of the former Rybinsk Okrug, the southwestern part of Yaroslavl' Okrug, and the northwestern part of Aleksandrovsk Okrug and comprises the northernmost belt of mixed evergreen-deciduous forest.

This region, which is not large, represents the extension of the adjoining Bezhitsa region V₍₁₎ of Moscow Oblast, and is distinguished from all other regions of Ivanovo Oblast by the considerably greater moisture of the growing period, as well as by the wide distribution of podzolic, moderately loamy soils, based on boulder and cover clays. These conditions favor the development of fiber flax culture and make the region one of the best in the USSR for the natural selection of flax.

The significance and composition of crops and their varieties is the same here as in the comparable region of Moscow Oblast, with special emphasis on high-quality flax.

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VI(4) Humid Ivanovo-Voznesenskiy Rayon, with heterogenous soil.

Southeastern part of the former Yaroslav Okrug, the Alexandrov Okrug (except for its northwestern section), the northwestern parts of the Vladimir and Shuy Okrugs, and the southwestern part of the Kineshemak Okrug. In the north^{there is} a belt of mixed forests, and in the south small azonal sectors of broad-leaved forests and oak forests. Bottom land vegetation^{is found} along the rivers. Of the main soil mass of the ^{region} Rayon, composed of turfy-podsolic argillaceous-loamy soils, arenaceous-loamy soils, arenaceous, and alluvial soils ^{subregion} (Pod^{region}rayon "a"), the Yur'yev-Pol'skiy azonal sector should be distinguished. In this area we find fertile gray forest argillaceous-loamy soils and chernozem-like soils on loess ("opol'ye", subdistrict).

The frost-free period here is around 120-130 days; the total heat during the growing season is around 2000 degrees. The average temperature for July is 18.5-19.0 degrees Centigrade, for January around minus 12.0 degrees. Because of summer rains, the ^{region} Rayon is humid in the northwestern part and, in comparison, moderately humid in the southern part. The winter is comparatively snowy (the average maximum height of the snow is more than 50 centimeters). This is the most densely populated Rayon of the Oblast, with a number of large industrial centers. Agriculturally, it should specialize in producing vegetables, fresh milk and sour-milk products, potatoes for kitchen, fodder, and industrial use, to satisfy the needs of the manufacturing centers, as well as ^{to} continue to raise the crops in which the ^{region} Rayon has previously specialized (these, also, both for local processing and export): chicory, green peas, onions, horse-radishes, hops.

In addition to a general emphasis on milk and vegetables, flax should become one of the basic crops, while in arenaceous soil

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districts potatoes, for consumption and industrial use, should be the main crop.

The southern ^{subregion} Podrayon ("b"), with its fertile soil, is engaged mainly in dairy farming and vegetable raising, to meet the tremendous demand of the great industrial centers of the Ivanovo and Moscow Oblasts. Along with development of potato sowing, this ^{subregion} Podrayon ought to produce winter grains and oats -- in quantities large enough that they may be sent to outside markets. For winter grains and oats, ^{subregion} Podrayon "b" possesses very favorable conditions, the best in the oblast.

Fodder crops of the Rayon are the same as in the preceding rayons, but growing conditions here permit a wider selection of varieties, allowing us varieties of greater yield and higher quality.

Of the grains, winter rye ("Vyatka" variety) and oats ("Moskovskiy A-0315") are basic, with winter wheat, peas, and fodder lentils very important as secondary crops. The latter three, especially winter wheat, should become more important in the southern ^{subregion} Podrayon of chernozem-like soils and forest argillaceous-loamy soils. Rye should be very strongly discouraged in favor of winter wheat; for, in addition to sufficiently favorable climatic conditions, winter wheat has here very suitable soil (the variety "Moskovskaya 02411" is recommended). The Swedish fly is widespread in the south, which hinders barley and spring wheat cultivation.

On arenaceous soils along the Kotorosl' and Nerla, and in other places of arenaceous soils, lupine should be a basic crop for soil-enriching. Of secondary crops, it is possible that certain medical plants could be successfully cultivated: valerian, camomile, scopolia.

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VI(5) The Klyaz'ma-Oka watershed, moderately humid, with arenaceous-loamy and arenaceous soils. Southeastern parts of the former Kineshem, Shuy, and Vladimir Okrugs. Mixed conifer-deciduous forests, predominantly pine. Bottom-land vegetation along the rivers. Reed, grass, and moss marshes.

The frost^{-free}less period is around 130 days; total heat during the growing season is 2,000-2,200 Centigrade degrees; the average July temperature is approximately 19.3 degrees Centigrade, and the average January temperature, minus 11.0 to minus 12.5; the total precipitation during the growing season is considerably less than in the preceding districts (around 160 millimeters for May-July). The soils are chiefly pine-forest, argillaceous sands and turfy-podsolic arenaceous-loamy sands. In the east there are small amounts of argillaceous-loamy soils and weakly podsolic argillaceous-loamy soils on loess. Along the Klyaz'ma and its more important tributaries, ^{are found} alluvial bottom-land soils. In the eastern part of the district on the cohesive argillaceous-loamy soils, the cultivation of coarse-fibred flax is possible, with utilization of power from the Shaturskaya power plant for processing. Here, if necessary, flax may be one of the basic industrial crops; but for the whole district, due to the insufficient moisture and surplus heat of the summer and the large extent of sandy soils, flax may be in general only a secondary crop.

Together with fodder crops for dairy farming, potatoes -- utilized in all ways, for fodder, kitchen, and factory -- should be a basic crop here.

Natural fodder resources, except for lowland places in the south, are insufficient for the rapidly expanding dairy farming and pig raising, and a comprehensive plan for securing fodder from fields

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and meadows is necessary. Fodder crops of the district include the following: one-crop clover, with timothy and a vetch-oats mixture for hay; for silage: sunflower, corn, the ^{horse-}~~broad~~ bean, sweet clover; vetch-oats mixtures, clover, serradilla, buckwheat, Jerusalem artichoke, and fodder cabbage; root-tuberous plants: beet, turnip (Brassica napus rapifera), potato, carrot; succulent green fodders for fattening ~~and~~ livestock: rye-oats-vetch mixtures, vetch-oats mixtures, one-crop or two-crop red clover, serradilla, white mustard. Of grain crops, winter rye ought to be the basic crop here ("Vyatka" variety). Oats require a large amount of moisture, and the decrease in precipitation which we find in this district of very water-permeable soils considerably affects the amount and reliability of the harvest. Moreover, the poor soils demand more frequent fertilization and the application of more valuable crops. The oats variety "Moskovskiy A-0315" is recommended here. Barley and spring wheat are not reliable here because of the intensive activity of the Swedish fly and because of the character of soil-climatic conditions. The lack of barley and spring wheat ought to be compensated for by an increase in cultivation of grains for groats: buckwheat and peas -- and also fodder lentils.

It is especially necessary ~~that we~~ ^{to} utilize lupine and serradilla in this district.

Therefore, field cultivation in the Ivanovo Industrial district in general is specializing ~~in~~ ⁱⁿ large-scale organization of fodder-procuring and increasing the development of technical crops: flax and potatoes and industrial vegetable raising.

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VII. NIZHEGOROD KRAY

The separate parts of this vast kray were formerly extremely isolated, with no unifying economic connections. For this there were a number of socio-economic reasons, among them the lack of internal transportation links and a lack of planned specialization in certain types of industrial production, and especially the general economic structure, which was extremely backward (with home handicraft work instead of factory organization). This was also due to the disadvantageous geographic position of the kray between the industrial Ural and Central ^{areas} ~~objects~~, and, in some degree, to the diversity of nationalities which the kray contains. The closer cooperation of the basic branches of the economy -- the timber industries, agriculture, and manufacturing -- in the interests of production, has greatly increased during recent years, due to the development of communications construction, the granting of autonomy to the national minorities, the collectivization of agriculture, and the geographical reorganization of the kray within new boundaries, with Nizhniy Novgorod as the leading industrial center, communications center, and center of trade for the timber industry of the kray.

The most important sections of the people's economy in this kray, aside from the rapidly developing industrial production, are the timber industry, the cutting and milling of the wood, and agriculture, with specialization of the latter, in individual areas, in flax cultivation, dairy farming, pig raising, partly in grain of gray cereals and potato cultivation.

The development of a method for industrially obtaining rubber from alcohol, and the current necessity for producing fuel alcohol with the presence here of the Nizhegorod Motor Works, together with

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the fact that huge areas of arenaceous soils are available for potato production -- all these can bring about a tremendous increase in the cultivation of potatoes.

The development of transportation facilities makes it increasingly possible to export the kray's products to outside areas -- previously this was practically the only productive region in the immense territory of the non-chernozem northland of the European part of our land. Phosphorus beds, combustible schists, and iron ore in the Omutnin mining district, metallurgic works, sawmills, paper mills, match factories, glassworks, distilleries, soap works, and a number of other factories, and, finally, machine-building and automobile works in the southern part of the kray, all make up a large extracting and processing industry, forming together with the very important agriculture and forestry the mixed economy which characterizes the kray.

Natural conditions in the kray are very diverse and very greatly affect the general structure of agriculture, and, especially, determine which crops are to be cultivated.

With regard to climate, the kray belongs to the eastern, more continental, districts, which have much less summer precipitation and a considerably longer growing season and greater total heat as we go farther south. The soils vary from peat bogs, sands, and podsoils to marly argillaceous loamy soils and varieties of chernozems. Hence we have here completely favorable conditions for a large expansion of flax cultivation, while at the same time there are places where the least demanding of gray cereals turn out poorly. Just so, the extent of forests -- which constitute the wealth of the kray, and are indicative of the feasibility of agriculture -- is 15 percent or less of the total area in some central and southern

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sections of the kray, and as high as 80 percent in extreme northern sections. Climatic conditions and the geography of soil fertility have greatly influenced the distribution of the population. In certain oversettled sections, the rural population has already taken up more intensive forms of farming: flax cultivation, dairy farming with hay and straw as fodder, pig raising, etc., while in other sections the population has developed livestock raising on widely available natural meadows and pastures.

The various combinations of natural and economic conditions may be fundamentally grouped as follows:

VII(1) Marsh-woodland district of the upper Vyatka River. The northern parts of the former Vyatka Okrug, the Votyak Autonomous Oblast, and the Kotel'nich Okrug, and the northeastern part of the former Shar'in Okrug. Southern coniferous forests of an eastern aspect (chiefly firs). Reed and moss marshes.

The frost-free period is here only around 110-125 days in all; total heat of the growing season is 1,600-1,800 Centigrade degrees; the average July temperature is around 17.5 degrees, the January temperature - 14 to 16 degrees Centigrade. The climate's severity is considerably tempered by the great amount of summer (more than 175 millimeters for May-July) and winter precipitation. The very podsollic argillaceous-loamy soils prevailing in the region alternate with arenaceous-loamy soils and sands along the rivers. There are several large marsh areas, chiefly juncaceous. The natural fertility of the soils is low, but with fertilization they give very high and reliable harvests. Warmer, elevated places are being chosen for agriculture. In the southern part of the district, great harm is being done by the winter grain borer, thus increasing

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the importance of summer cereals. The district is very woody. In the east, Omutnin mining construction and a metal-working industry are developing, occupying a large part of the workers of this district of little agriculture.

Because the district is not densely populated and is isolated, the development of dairy farming is sufficiently provided for here, on a basis of utilizing natural pasturage, hay fodder, and grass sowing, but with progress in the application of machinery and chemistry, favorable climatic conditions in the district ought to be utilized also for the development of flax raising, for which natural conditions here assure the obtaining of fiber of good quality, but the development of which is greatly hindered by the lack of workers and the necessary basis of machinery. With few roads, and in the northeastern part almost isolated, this district can and ought to raise grain production, especially oat cultivation in timbering sections, on a scale large enough to satisfy the demand, and ought to provide the population of the northeastern part with its mining and metal-working industry with vegetables and potatoes. The potato, utilizing it also as fresh fodder for cows, thus ought to be a secondary crop.

The present relatively poor meadows and pastures are insufficient for the requisite development of dairy farming, and organization of more intensive fodder-procuring and utilizing of a number of fodder crops is doubtless necessary. Of these, the following can be utilized successfully: for hay -- clover (one-crop), by itself and with timothy, vetch-oats and pea-oats mixtures, a number of cereal grasses; for silage -- sunflower, pea-oats and vetch-oats mixtures, red clover; these ought to be widely tried -- the ^{horse-} ~~bread~~ bean, buckwheat, the Jerusalem artichoke; root-tuberous

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plants -- potatoes, turnips (Brassica campestris rapifera and Brassica napus rapifera); fresh green fodders for fattening up livestock -- rye-oats-vetch mixture, peas and vetch-oats mixture, red clover, white mustard.

Winter rye ("Vyatka" variety) and oats ("Zhemchuzhina" ["Pearl"] variety, or, if this is scarce, the variety "Zolotoy Dozhd" ["Golden Rain"] is acceptable) ought to be the most important of the grain crops, but barley, which has favorable conditions for itself here, ought to supply the demand for groats and also for concentrated pig fodder (the variety "Vyatskiy Ol009" is acceptable). It is necessary to give proper development to peas for kitchen use and especially to ^{field peas} "polyushka" for fodder.

VII(2) Vetluga district of arenaceous and arenaceous-loamy soils.

The former Shar'in Okrug except for the northeastern part, the central part of the former Kotel'nich and northern Nizhegorod Okrugs. Southern coniferous, chiefly pine, forests.

As regards the length of the growing season and the period of field work, the northwestern part of the district (VII(2a)) is considerably different from the southeastern (VII(2b)); while in the first the frostless period is in all only 110-120 days, in the second it lasts up to 130 days. The total heat of the growing season correspondingly varies from 1,800 to 2,000 degrees. The average July temperature in the district is 18.0-18.5 degrees Centigrade, while the January temperature is around minus 13.5 degrees Centigrade. There is a large amount of summer precipitation, as well as of winter snow.

The podsollic soils here represent pine-tree sands, turfey arenaceous-loamy soils, rarely argillaceous-loamy soils.

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This district has the best-developed lumbering industry in the kray.

The favorable climatic conditions call for the development of flax raising on the cohesive soils, but the predominant soil conditions bring about the great expediency of developing potatoes and fodder crops. The flax fiber of the more humid Kotel'nich part of the district is notable for an exceptional softness and fineness.

These two crops, with the simultaneous development of vegetable raising and the raising of grain crops to the point where local needs for bread and concentrated fodder may be met, are basic, determining the general character of the district's agriculture -- dairy farming and flax cultivation, with the large specific gravity of the potato for fodder and industrial purposes. The general assortment of fodder crops is here the same as that of the preceding district, with the addition in the south of a southern subdistrict of corn and lupine. Here serradilla on arenaceous soils and sweet clover, beet, and carrot on cohesive soils ought to be widely tried.

Grain crops, also, have the same importance, with two exceptions: barley, which, due to soil conditions, is here a minor crop, and leguminous plants -- peas, especially for fodder, and, in the southern subdistrict, also fodder lentils -- which are here more important. Varieties: rye -- "Vyatka", oats -- "Lokhovskiy", "Pobeda" [Victory] admissible in the southern part and "Zolotoy Dozhd" [Golden Rain] in the northern; barley -- "Professor Viner" in the southern part, the earlier "Kol'khikum 10/30" everywhere admissible; beans and the indigenous Ural lentil.

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The cultivation of lupine on arenaceous soils ought to be especially developed here.

VII(3) Vyatka-Votyak flax-raising region. Southeastern part of the former Kotel'nich Okrug, the southern Vyatka and Nolinsk Okrugs, the Votyak Autonomous Oblast except for the extreme northern part, and the northeastern part of the Mariysk Autonomous Oblast. The belt of southern coniferous forests of the eastern type in a transitory stage to being mixed forests, almost devoid of marshes, is very well known; the district is greatly cultivated. The growing season becomes longer here and the total heat greater, while the amount of summer precipitation considerably lessens and the temperature of the summer months increases. Despite the somewhat more continental climate, the combination of the heat cycle and precipitation is very favorable for agriculture, which consists of flax, fodder crops, and the grain crops: leguminosae and gray cereals.

The frost-free period here is 125-140 days; the total heat of the growing season is 1,800-2,000 Centigrade degrees; the average temperature for July is around 18.5 degrees Centigrade, for January 14.5-15.5 degrees; a moderate amount of summer precipitation (160-170 millimeters for May-July) and a relatively snowy winter (the average maximum height of the snow covering, over many years, is around 60 centimeters).

In the northern half of the district, the winter borer is exceptionally active.

In general, soils are rich, representing podsollic argillaceous-loamy soils, with greatly varying degrees of podsollic development, developed mainly on the products of the erosion of Permian red soils. The most fertile of the weakly-podsolic soils of the raised plateaus

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in the northeastern and southwestern parts of the district are marlaceous argillaceous-loamy soils. In the south, in the right-bank district of the Vyatka River, these are adjoined by an area of dark-colored still more fertile argillaceous-loamy soils, alternating with marlaceous-calcareous soils. Besides different soils, the section has a different climate (great length of the growing season, heat, and aridity), and so it may be distinguished as a special subdistrict (VII(3b)). Soils of an arenaceous-loamy type, produced from alluvia of Permian sandstone, and sands, more common in the east in the left-bank area of the Vyatka and its left tributaries, are also widespread.

There are many factories of various kinds in the district, among them the huge Izhevsk Metal-Working Plant. The number of plants for the initial processing of flax ought to be rapidly increased.

The relatively continental climatic conditions unfavorably affect flax quality, which is higher in the north than in the central and southern parts of the district. Nonetheless, this district, second to the Pskov district in fiber production, ought to cultivate flax as a basic crop. The large size of the ploughed area and the smallness of natural fodder areas call for the development of intensive livestock raising, obtaining fodder from cultivated fields and bringing under cultivation natural fodder fields of little productivity. However, considering the deficiency in bread and concentrated fodders of the adjacent roadless northern and western districts of the Nizhegorod and Northern krays, in this "bread granary" of the northeast, grain production -- though not to the detriment of flax production -- ought to be generally increased.

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Grain crops should be concentrated in the southern, more arid, subdistrict of gray forest and marlaceous argillaceous-loamy soils (VII(3b)), less favorable for dolgunets [a type of flax giving long, good fibers] but very valuable for grain crops.

While, in general, flax ought to occupy the argillaceous-loamy sections of the Glazov-Nolinsk, Yaransk and other argillaceous tablelands of a smaller area, arenaceous soils of the Vyatka River basin and the Udmurt district can be widely utilized in cultivation of kitchen, fodder, and industrial potatoes. Fodder crops ought to be everywhere cultivated, in combination with flax and potatoes, with the emphasis varying in different places according to the general line of farming and cattle raising development.

The same fodder crops ought to be cultivated as in the preceding district, with a more intensive planting of ensilage crops, green fodders for fattening ~~up~~ livestock, and root plants, and with a development in clover sowing, which is essential here to improve the flax yield. In the southern (VII(3b)) and eastern parts of the district, with the decreased humidity of the growing season and the increased severeness of winters, ^{alfalfa} ~~lucerne~~ (hybrid ^{alfalfa} ~~lucerne~~) should be very important. In the district of the towns Izhevsk and Vyatka, and also in sections of concentrated small industry -- in the Slobodsk, Glazov, Kotel'nich, and Yaransk districts -- large-scale development of vegetable raising is called for.

The basic grain crops are winter rye ("Vyatka" variety) and oats ("Mirazh" [Mirage] variety, and, admissible, "Pobeda" [Victory] variety). But it ought to be noted that, in the northern and especially the eastern part of the district, barley gives very good harvests -- holding ^{its} ~~their~~ own in comparison with rye. In addition, the barley grain obtained here gives not only very good groats and

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even better fodder, but also excellent material for beer brewing (the variety "Professor Viner", and, admissible, the early forage-groats variety "Kol'khikum 10/30"). Therefore, besides being generally important as a subsidiary crop for the entire district, with a special assignment to fulfill on argillaceous-loamy soils of the northeast section, barley may also become a basic crop, as fodder, with expansion of pig raising, or for supplying beer breweries. Its importance considerably decreases towards the south, owing to the activity of Swedish flies. Spring wheat, which is more resistant to pests than barley, can be used as a subordinate crop in districts of gray and dark-gray argillaceous-loamy soils, whereas any great enlargement of winter wheat cultivation seems at present doubtful, despite the presence of excellent "winter wheat" soils. In the very near future we must organize the most large-scale tests of varieties of winter wheat selected for the Vyatka and Volga areas and tests of methods of cultivation, in order to ascertain where this crop, more valuable than rye in the north, can be introduced.

Buckwheat must remain a minor crop, but special attention should be given to increasing the sowing of peas and fodder and kitchen beans, as the great importance of these crops for food, fodder, and agricultural engineering in this district coincides with completely favorable conditions for their development.

VII(4) Murom lowland on arenaceous soils. The former Murom Okrug, the southern part of the Nizhegorod and the central Arzamas Okrug. Mixed coniferous-deciduous forests, with a great predominance of pines, on sands.

Despite its relatively southern location, the frostless period here is the same as in the preceding district, around 130

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days, but the summer is hotter, and the total heat of the growing season is 2,100-2,200 Centigrade degrees; the average temperature in July is around 19.5-20.0 degrees Centigrade, in January minus 11.5 to minus 12.0 degrees. With the moderate amount of summer precipitation for May-July around 160 millimeters in connection with the water-permeability and little moisture-holding capacity of arenaceous soils, in individual years a lack of moisture is felt.

Soils of this district are found in branch-like contours, stretching along the river valleys of the Oka-Tesha, the Serezhka, the Moksha and their tributaries -- mainly sands and alluvia of bottom lands, which are broad here, more rarely argillaceous sands, arenaceous-loamy soils, and argillaceous-loamy soils. The ploughed area in the district is not very large, and the total forested area is considerable. The district is well linked by railroads and waterways with Moscow, Novyy Novgorod, and a number of other industrial centers. The natural productive resources and the good transportation links with industrial centers determine, thus, the general direction of the district's agriculture, based on utilization of watered meadows, forest pastures, and meadows, and wide utilization of arenaceous soils in cultivation of table, fodder, and industrial varieties of potatoes. In districts of cohesive soils, conditions are still suitable for flax cultivation, and good harvests may be obtained, although of coarse fibers. In case of need flax may still be a very important crop in such places. The general importance of grain crops is determined by the possibilities of supplying local needs and of providing the cattle with fodder.

Grain crops here are the same as in the southern part of the Vetluga arenaceous district of this kray (VII(2b)). Among the grain crops, winter rye ("Vyatka" variety) and oats (Moskovskiy A-0315", and,

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admissible, "Pobeditel'-Dippe") are also basic. Buckwheat is of secondary importance, but leguminous plants -- lentils and table and fodder peas -- must be in every way developed. Lupine ought to be widely utilized, for enriching the soil and as material for ensilage. The general proximity of this district to large industrial centers, and the good railroad links, calls for maintaining present centers of vegetable cultivation here, with its Murom vegetable varieties and its great experience in seed growing.

VII(5) The forest-and-steppe Arzamas district. Southeastern part of the former Nizhegorod Okrug and the Arzamas Okrug except for the central part. Northern forest-and-steppe of various grasses with islands of broad-leaved forests, greatly cultivated.

The growing season is somewhat longer than in the preceding district (the frostless period is 130-135 days). While the amount of summer precipitation somewhat lessens (up to 150 millimeters for May-July), the temperature of the summer months increases (the average for July as high as 20 degrees Centigrade) and the winter temperature falls (average for January as low as minus 12 degrees). Thus the climate of the district, in comparison with preceding districts, is considerably characterized by continental features.

The soil consists of gray forest argillaceous-loamy soils, chernozem-like soils, and average chernozems; peaty-podsolic argillaceous-loamy soils are rarer. Along the Oka and Volga, alluvial bottom land soils. The strongly continental climate and the character of soil conditions limit the cultivation of flax, which is greatly depressed here, surviving mainly in rare patches in areas where there is greater moisture, on podsolic soils. Hemp is replacing flax here.

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The potato, especially in the Nizhegorod group of northern industrial centers, which are located on Volga and Oka bottom lands and are causing a development of dairy farming in parts of the region, ought to be widely cultivated as a secondary crop, to satisfy food demands and also to supply the developing of pig raising and dairy farming.

To coordinate with other northern districts of the kray territory which specialize in flax, fodder crops, and potatoes, and also to satisfy its own needs, this district should emphasize grain crops in general. Of these, rye ("Avangard" vanguard variety) is best provided for by natural conditions. Oats are somewhat less reliable, due to the fact that precipitation in this district also decreases, and among the grain crops it ought to be a secondary crop (varieties: "Moskovskiy A-0315" and, admissible, "Pobeditel'-Dippe"). In this category of secondary crops among the grains, we ought to include the production of vetch seeds, of which we have not enough. On chernozems and forest argillaceous-loamy soils, a still wider expansion of spring wheat sowing is possible, to a point where spring wheat is of at least secondary importance among grain crops (the variety "Cezium 0111" admissible for the time being, and "Lyutestsens 062" somewhat subject to crumbling but early and very productive). Special attention should be paid to the development of peas and small-seed fodder lentils, and also of vetchling, all of which have here fully suitable conditions available. Buckwheat also should remain a secondary crop, as should millet, while spelt and barley should gradually give way to other crops more valuable here, as in the district VII(3) of this territory. Setting up broad experiments in the very near future with Volga

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varieties (Vyatka, Kazan', Simbiley, etc.) ought to indicate places where this crop could be introduced.

These fodders ought to be cultivated: for hay -- one-crop clover with timothy and a vetch-oats mixture; for silage -- sunflower, corn, vetch-oats mixtures, red clover, vetchling, lupine, sweet clover, ^{horse-}~~bread~~ bean, buckwheat, Jerusalem artichoke; root-tuberous plants, depending on the combination of natural and economic conditions, may be chosen from sugar beets, potatoes, turnips (Brassica napus rapifera and Brassica campestris rapifera) and carrots; rich green fodders for fattening ~~up~~ livestock include rye-oats-vetch mixtures, vetch-oats mixtures, one- and two-crop red clover, hybrid lucerne, and sweet clover.

The northern part of the district, the nearest to Nizhniy Novgorod, Sormovo, Balakhna, and a number of other smaller industrial centers, ought to develop vegetable and berry farming on a large scale, with a wide assortment of crops and varieties possible.

VII(6) Mari district, on arenaceous soils. Mari Autonomous Oblast except for the northeastern part, and the central part of the former Nizhegorod Okrug. Mixed forests, with a great predominance of pines. In the eastern part, many mossy peat bogs.

Frost-free period around 130-135 days; total heat of the growing season 2,000 Centigrade degrees; average temperature for July around 19.1 degrees Centigrade, for January minus 14 degrees; moderate precipitation for the summer months (around 160 millimeters for May-July). All this indicates that the climate of the district is to a considerable degree continental.

Soils of the district are mainly pine sands, with a lesser amount of peaty-podsolic arenaceous-loamy soils on the northern border.

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Marshes in the Volga and Vetluga watershed area. Alluvial soils along the rivers. The district is greatly forested; forests of high quality; the forest industry greatly developed.

These conditions define the general character of the district's agriculture as an economy of livestock raising, utilizing watered meadows; fresh-milk production in the area of the small but numerous industrial centers along the Volga and Vetluga. The poor arenaceous soils may be most rationally utilized here in cultivation of fodder plants and of table, fodder, and industrial potatoes. The assortment of fodder crops is the same here as in the southern subdistrict of the arenaceous Vetluga district (VII(2b)).

Cohesive soils in the northwest, northeast, and in the south (in the Mari mountainous district) may be utilized for expanding flax cultivation, and flax, thus, may be generally a supplementary crop in the district.

Grain crops, with sufficient fertilizer, may satisfy local needs for bread and groats as concentrated fodder for dairy cattle and pigs; and oats is also needed here for horses in lumbering areas. The more demanding barley and spring wheat are not suitable for most of the district (with the exception, because of a number of conditions, of the Mari mountainous district). Only on the northern borderlands of the district, in the very small sections of more fertile soils, they may be of a certain minor importance (barley: "Professor Viner" variety or the earlier "Kol'khikum 10/30"). A minor crop, but cultivated throughout the district, should be buckwheat. Cultivation of peas and vetch for seed ought to be in every way developed.

Owing to the relatively small amount of precipitation for the very water-permeable soils, harvests of oats are insufficiently stable

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here, and, despite the large local demand for oats, it ought to remain among supplementary crops; at the same time, winter rye remains of basic importance. Varieties: rye -- "Vyatka"; oats -- "Moskovskiy A-0315" and, admissible, "Pobeda" Victory7.

Lupine ought to be introduced as green fertilizer on a large scale.

The heavily-populated industrial centers demand the organization of vegetable raising centers nearby.

VIII. CHUVASHI ASSR

The general character of agriculture and the natural environmental conditions in this republic are in general similar to those of the neighboring Arzamas Rayon (VII(5)). The relatively small area of the republic, rather homogenous as regards climate, may be divided, mainly according to soil conditions, into the following two parts:

VIII(1) Chuvashi chernozem district. This district occupies the large northeastern part of the republic (virtually the entire area except for the Alatyr' and the southwestern part of the Ibresi Rayons). The northern varied-grass forest-and-steppe is very heavily cultivated. Bottom-land vegetation ^{is found} along the rivers.

The frostless period is 135-140 days; the total heat of the growing season is 2,100-2,200 Centigrade degrees; the average temperature for July is around 19.5 degrees Centigrade, for January minus 13.5 degrees. The amount of summer precipitation falls rapidly from moderate in the northwest to insufficient in the southeast, creating here a serious threat of drought (precipitation for May-July 150 millimeters to 125 and below).

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Dark-gray forest-and-steppe argillaceous-loamy soils and average chernozems predominate. Along the Volga a belt of weakly podsollic soils. In the Sura and Volga bottom lands, ^{are found} alluvial soils.

The Swedish fly and the winter-grain borer are very active.

The northern part of the district is well linked by railroads and waterways.

Thus, the character of soils and climate here considerably hinders the development of crops usual for the more northern rayons. Flax, in an intermediate spinning-oleaceous form, and hemp ought to be among the tertiary [minor] crops here, and potatoes among the secondary [supplementary] crops. The natural prerequisites exist for a development of intensive livestock raising -- dairy cattle and pigs -- for fodder-procuring utilizing watered meadows, with an intensive fodder cultivation on a part of the fields and utilizing local grain, mainly winter rye, for which better conditions are available than for other grain crops.

We have a valuable assortment of fodder crops here: for hay -- one-crop red clover with timothy, vetch-oats mixture, hybrid ^{alfalfa} lucerne; large-scale experimental sowings of Sudan grass should be made; for silage -- sunflower seeds, corn, vetch-oats mixtures, the Jerusalem artichoke, lupine, buckwheat, white mustard, sweet clover, vetchling; root-tuberous plants -- potatoes, beets, carrots, in moister areas turnips (Brassica napus rapifera and Brassica campestris rapifera); rich green fodders for fattening ~~up~~ -- rye with winter vetch for an early spring fattening fodder, clover, corn, vetch-oats mixture, hybrid ^{alfalfa} lucerne, white mustard, sweet clover, Sudan grass.

Among grain crops, winter rye ("Avangard" variety) ought to remain basic. The oats harvest here drops considerably; oats ought

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to remain only a secondary crop ("Moskovskiy A-0315" variety, and, admissible, "Pobeditel'-Dippe"). Spring wheat should be expanded, supplanting spelt, to no less than a secondary grain crop (the variety "Lyutestsens 062" for the time being admissible), and among minor crops ought to be vetchling and buckwheat. Sowings of buckwheat, fodder lentils, and vetch for seed ought to be in every way expanded.

VIII(2) Sura sands and bottom lands. Small district in the southwest of the republic. Forest-and-steppe, with areas of pine woods.

This district differs from the preceding one mainly in the character of the soils (arenaceous and arenaceous-loamy) and in its great amount of forests. As regards climate, it is very similar to the southern part of the preceding district. Soils of the district -- watered meadows, forest pasture lands and meadow lands, and arenaceous soils, the latter very suitable for cultivating fodder crops, especially potatoes -- determine the agriculture of the district: dairy farming, with concomitant pig raising.

Fodder crops are almost the same as in the preceding district: one-crop clover with timothy and a vetch-oats mixture for haying; sunflower seeds, vetch-oats mixture, corn, Jerusalem artichoke, vetchling, lupine, buckwheat, and serradilla for silage; root-tuberous plants -- potatoes, beets, carrots; rich green fodders for fattening up livestock -- rye-oats mixture, clover, corn, vetch-oats mixture, white mustard, hybrid lupine.

The area of grain cultivation ought to be considerably smaller here, and the preceding district should undertake the task of providing this Rayon with concentrated fodders and bread. Grain crops and varieties are the same in this district as in the preceding one. Owing to soil conditions here, the possibilities of expanding wheat sowing are small.

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Already here we find flax not among the technical crops, but hemp remains, as a minor crop. If necessary, potato cultivation for industrial purposes can be increased.

Lupine should play an important role in improving the fertility of the poor sandy soil of the Rayon.

Generally speaking, conditions in the Chuvashi Republic provide best for winter rye, fodder crops, and potatoes, which aids the development here of cattle raising, for milk and for meat, and poultry raising.

IX. TATAR ASSR

The general conditions of the Tatar Republic, located in the north of the chernozem belt, give it the same basic agricultural character as the Chuvashi Republic; but in the eastern part of the forest-and-steppe, with its potent chernozems, we find a great amount of grain cultivation, for here considerably stronger continental conditions are already noticeable, which greatly limits the extent of insect pests and permits relatively widespread cultivation of spring wheat. The longer growing season, with a corresponding increase in total temperature and smaller amount of precipitation, considerably changes the assortment of crops available here.

The republic can be basically divided according to climate, soil conditions, and extent of forests into two parts approximately on a line along the Volga and Kama.

IX(1) The forested Tatar Kama area. The part of the republic located to the north of the Volga and Kama. Mixed (subdistrict "a") and broad-leaved (subdistrict "b") forests, very reduced. Apple

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trees steadily developing. Vegetation of the wide river bottom lands.

The frostless period is 135-145 days; the total heat of the growing season is 2,000-2,200 Centigrade degrees; the average temperature for July is around 19.5 degrees Centigrade, for January around minus 14.5 degrees; the amount of summer precipitation is not large, and decreases very quickly as one goes further south (from 150 to 125 millimeters and lower for May-July); the snow cover is sufficiently high, but also quickly decreases in a northeast to southwest direction (the average maximum height of the snow cover is 70 to 50 centimeters).

Soils of the district are almost exclusively gray forest argillaceous-loamy soils, with an insignificant amount of podsollic argillaceous and arenaceous soils in the northwest of the district. In the valleys of the Vyatka, Kama, and Volga are wide belts of alluvial soils.

The district is relatively well provided with means of communication, especially waterways; it includes large (Kazan') and a number of small industrial centers; a large expanse is served by a well developed transportation system along the Volga and the Kama.

The foregoing form the premises for an expansion of field fodder-procuring, the utilization of the rich soils for grain crops, and an expansion of potato, vegetable, and fruit cultivation, and to a certain extent in the north flax cultivation.

To supplement natural fodder resources from watered meadows, fodder cultivation ought to be expanded: for hay -- one-crop red clover with timothy, vetch-oats mixtures, hybrid ^{alfalfa} lucerne and ^{beardless} stalkless brome grass; for silage -- sunflower, corn, vetch-oats mixtures,

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sweet clover, Jerusalem artichoke; root-tuberous plants -- beets, potatoes, turnips (Brassica campestris rapifera), carrots; rich green fodders for fattening livestock -- winter rye, vetch-oats mixtures, one-crop clover, and corn.

The basic grain crop here ought to be winter rye ("Avangard" variety and -- for the time being, until selecting work can be done here -- the previously much-propagated "Vyatka"). Oats harvests are somewhat unreliable because of the greatly lower amount of precipitation, and this crop can be a supplementary crop among grain crops ("Moskovskiy A-0315" variety, and, admissible, the previously introduced variety, "Pobeda"). Among supplementary grain crops ought to be included -- possibly with an expansion in their sowing area -- peas and fodder lentils. Secondary crops can be: spring wheat (for the time being, the variety "Lyutestsens 062" admissible), buckwheat, and, in the north, barley, replacing spelt, which is of little value. Growing season conditions permit the introduction of crops of vetch and vetchling for seed. Potatoes, in addition to being important as food and fodder, ought to be utilized here for processing into alcohol, starch, syrup, sago, etc. Among secondary technical crops, flax also ought to be included (primarily intermediate-grade, but in places in the very north also long fibered), with caraway also possibly expanded.

IX(2) Northern Tatar forest-and-steppe. In connection with our arrangement of material by administrative and territorial units, both the forest and the forest-and-steppe parts of the Tatar Republic are here conditionally included in the northern forest belt, in the same way as a number of similar natural zones of the Ural Oblast and the Western-Siberian Kray are considered as entirely in the section of southern chernozem krays and oblasts. A part of the republic

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located to the south of the Kama and the Volga. Greatly ploughed northern varied-grass forest-and-steppe, with sections of broad-leaved forests.

The frostless period for this relatively continental district is already very great (145-155) days; summer temperatures (July averages around 20 degrees Centigrade) and also total heat (2,200 Centigrade degrees and more) are high; the average January temperature is around minus 14.0 to minus 14.5 degrees; the winter is snowy (the average maximum height of the snow cover over many years is 60 centimeters). The district in individual years is considerably subject to droughts, which often appear in the northwestern part, where the average amount of summer precipitation often falls below 125 millimeters.

Soils of the district are on the whole very diverse, but all types are rich in humus. Here we find dark-gray forest-and-steppe argillaceous-loamy soils -- commonly argillaceous-loamy chernozems, more rarely arenaceous-loamy chernozems, and, for the most part in the east, rich chernozems. In narrow strips along the Kama and the Volga we find podsollic argillaceous-loamy soils and, in the valleys, alluvial soils. Hence soils of the district, rich in their natural fertility, include a diverse complex of transitional stages from podsollic soils of the north to rich chernozems of the south.

The Swedish fly, and in individual years also the winter-grain borer are very active here, but towards the east as the climate becomes more continental their activity considerably lessens. In general, agriculture can develop in the same direction as in the preceding district, but with grains here very important.

The basic grain crops here are still rye and oats. We should note that in connection with the decrease in the amount of summer

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precipitation, oats here yield less stable harvests; but at the same time the more arid harvesting period guarantees grain which is dry, fresher, clean (not "stained"), valuable for seed and worth exporting to outside markets. Which rye varieties are preferable is not established ("Avangard" is likely, and under cultivation at present is the variety "Bezenchuk yellow grain", propagated earlier and giving good results); in oats "Moskovskiy A-0315" is preferable ("Pobeda" for the time being is excluded from seed-growing work). Among supplementary crops, these deserve a greater area: spring wheat, peas, and, for kitchen use, lentils. It would be more expedient to proceed with spring wheat sowings on the potent chernozems of the eastern part of the district, which are better protected from the Swedish fly, but large-scale tests in sowing new varieties of this crop ought to be made also in the west of the district (the variety "Cezium 0111", valuable for mechanized farming because only slightly subject to crumbling). Natural conditions here are favorable for buckwheat, and it may be also kept among supplementary crops. Secondary leguminous plants: fodder lentils, vetch, and vetchling for grain and seed ought to be considerably expanded, while spelt, which is of little value, should be restricted in area. With the same conditions, sorghum remains among secondary crops.

Fodder crops here are the same as for the preceding district, however with relatively smaller possibilities of utilizing vetch and clover, due to the great aridity of the summer.

Among technical crops, potatoes, opium poppies, flax for linseed oil, and caraway can be successfully used.

Thus, fodder for meat and dairy cattle is first among crops of the Tatar Republic, and grain crops have a very considerable specific gravity.

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THE URAL - KUZNETS BASIN AREA

V. V. Talanov

Proceeding further to those districts and autonomous republics of the Cis-Ural area and the huge territory between the Ural and Altay mountain systems, we must not forget, in examining their natural conditions, that this area faces a tremendous industrial development, which is linked with the solving of the Ural-Kuznets problem.

This industrial development demands a corresponding expansion of agriculture, and of plant cultivation in particular. And the latter, in turn, supplying raw materials and consuming certain industrial products, is not without influence on the objectives and disposition of those branches of industry which are concerned with processing agricultural products. The great development in means of communication which is planned in connection with the Ural-Kuznets problem (the Siberian super-trunk line, the joining of the Urals, via Orsk, with the Central-Asiatic railway line, etc.) also should be a large factor in planning the development of agriculture of these districts.

Thus, as a result of existing and planned gigantic heavy industry -- the Magnitogorsk, Alapaevsk, Tagil', Kuznets, and Tel'bes plants, the super-trunk line linking the Urals with the Kuznets Basin, etc. -- in the reconstruction of agriculture, besides the general transition to kolkhoz and sovkhoz large-scale mechanized production, the following very important factors ought to be reflected:

(1) The demands for foodstuffs of the industrial districts of the mountain Ural and Kuznets Basin areas, and the partly mountainous centers of north Kazakhstan (Karaganda), in particular:

(a) An expansion of vegetable farming, potato production, and a development of dairy farming, with a corresponding expansion

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and intensification of fodder production in districts near mining and metallurgical centers; satisfaction of the needs of the working population of industrial centers for bread, grain leguminous plants, and cattle and poultry meat products;

(b) An increase of fodder resources for a development of dairy and meat livestock raising (grasses, root plants, silage), for feeding work cattle (oats for horses), which in the very near future cannot be replaced by mechanical power, and for poultry raising (waste products from the grain industry).

(2) Demands of the working population, a population which could greatly increase, of the Urals and the Kuznets Basin, and the possibilities of utilizing power resources not only in heavy industry but also in processing agricultural products, make essential the expansion and proper location of crops which yield the corresponding raw material (fiber flax, fiber hemp, sunflower seeds, hemp, and flax for oil, barley for beer-brewing, etc.)

As organizing links between agricultural production and the processing industry, construction of a number of large agricultural combines is planned, which will include both the sovkhoz and kolkhoz systems.

(3) The construction of new railway lines and the Siberian super-trunk line can also greatly change the area of consumption for the spring wheat regions of the Trans-Urals.

The aforesaid and other economic and social features connected with the Ural-Kuznets problem ought to be decisive in the reconstruction of agriculture, but in addition natural factors favoring higher production of this or that crop and influencing their proper allocation by districts ought to be taken into consideration.

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At the same time, natural conditions here permit such a specialization of its districts that it becomes possible not only to supply the area with the most important agricultural products, but the proper utilization of the Ural-Kuznets power system, fertilizer, means of communication, etc., can be reached; also, it becomes possible to utilize more widely the natural resources of the area and to increase shipments of this or that agricultural product to other parts of the Soviet Union or abroad.

For the resolution of the Ural-Kuznets problem in relation to agriculture it is necessary to note the fact that the large mining industrial centers of the Urals and the Kuznets Basin (Perm', Sverdlovsk, Tel'bes, Kuznetsk, Magnitogorsk) are either in foothill or mountainous districts. This situation is extremely favorable for the organization of vegetable and dairy farming. Total precipitation is comparatively large, and the climate is sufficiently mild and humid -- in comparison with the steppe districts of the plains -- which permits successful cultivation of fodder plants, in addition to available natural pasturage, and gives great possibilities of expanding dairy farming. The same natural conditions in foothill and mountain areas aid in the expansion of vegetable and potato cultivation, especially in that mineral fertilizer may be supplied from local plants and the power potentialities of metallurgical and industrial centers may be utilized for heating vegetable crops. The cultivation of barley for beer brewing is also possible here.

In those parts of the sub-tayga zone which are located near metallurgical districts, plant cultivation is possible along the same lines, and in addition the humid, often marshy zone of sub-tayga agriculture -- and especially the open foothill tayga -- is a

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supplier of flax and fiber hemp, also of oats, necessary not only in lumbering districts but for working livestock in mining. At the same time, with an expansion of fodder resources (clover sowing), butter making will also develop here, and nearer to industrial districts fresh milk production as well.

The abundance of moisture and natural haying and pasturage, with the development of ensilage and grass sowing, makes the district of the zaymischche-meadow steppes of Baraba a center of butter making, for supplying the working population of the Ural-Kuznets area as well as for shipping to other parts of the Soviet Union.

The huge expanse of the northern forest-and-steppe zone, still somewhat suffering from drought, will be an integral part of the zone of dairy farming, and at the same time a supplier of wheat with sufficiently reliable harvests to satisfy the needs of the population of the Ural-Kuznets industrial system.

The southern forest-and-steppe and the chernozem steppe, not having such favorable conditions for fodder-procuring, with, in addition, an arid climate, is the principal part of the spring wheat region of the Soviet Union. Although harvests are insufficiently reliable, due to the rather frequent years with insufficient precipitation, first-class grain is obtained here in sufficient quantity that it can also be exported, especially with construction of the super-trunk line. In addition, this is a district in which it is possible to promote sunflower cultivation on a large scale, which, together with cultivation of curly flax in this district and further south, can supplement the oil resources of the country. In the Barnaul'-Biysk district, the rich soils, with the amount of heat and length of the growing season sufficient, form a new district of beet sowing.

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Finally, the very arid southern steppes with chestnut soils of Western Siberia and Kazakstan, on which we find the yield extremely unreliable, though the grain here is first-class, is a district of specialization in spelt cultivation for groats (spelt being the most drought-resistant plant), with meat cattle and sheep raising developing as pasture lands expand.

Now let us sketch the natural conditions and agricultural possibilities of individual regions forming a part of the huge territory which the Ural-Kuznets problem encompasses -- the Bashkir Republic, the Ural region, Western Siberia, and northern Kazakstan.

X. THE BASHKIR ASSR

In accordance with the aforesaid, the general line of Bashkir agriculture and in particular the specialization of its field cultivation ought to fully reflect the demands which arise from the rapid planned development of Ural industry, a part of the UKK based on natural conditions of different parts of the republic. Common to all districts of the Bashkir ASSR are certain problems: first of all, of filling food needs of large industrial centers; also, realizing the possibilities inherent in power resources by the industrialization of farming and by the planned large-scale development of railroads, which will accelerate specialization by facilitating the transportation of agricultural products.

However, the influence of the UKK will be reflected in individual parts of the republic in different ways.

It will be especially strong in mountain and foothill areas, where the proximity of the Magnitogorsk giant of metallurgic industry, the reconstruction of the Belorets plant, situated within the boundaries of Bashkiriya itself, and the reconstruction of the very

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large Komarov-Zingazin plant, the expansion of non-ferrous metal combines and others, the construction of the Ufa-Magnitogorsk railroad line and the utilization of electrical sources of the latter for industrializing agriculture -- all these radically change the general line of agriculture, making the economy one of fresh milk, potatoes, and vegetables, with a development in every way of fodder-procuring and an intensification of agriculture, utilizing fertilizer on the poor soils of these sections.

Finally, the southern forest-and-steppe and the steppe part of Bashkiriya fall in the zone of wheat raising and some pig raising and cattle raising for meat, being the supplier of cereals for the metallurgic and industrial centers of the Urals as well as for shipping to other areas, as well as the supplier of meat and vegetable oil (sunflower).

Together with an increase in collectivization and mechanization, the main objectives of Bashkir agriculture on the whole ought to be for the very near future:

- (1) A great expansion of the sowing area in general and of the spring wheat area in particular, bringing new land under cultivation in the forest-and-steppe and especially in the steppe parts of the republic;
- (2) An expansion of grass sowing, of root crop cultivation and ensilage, as bases for a possibly large-scale development of livestock raising and especially of dairy farming;
- (3) An expansion of potato sowing and raising of the potato yield, with the introduction of varieties for kitchen, fodder, and technical use corresponding to the needs of the separate districts;

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(4) A further strengthening of sunflower cultivation, promoting towards the north and in the Trans-Ural region new, more quickly-ripening varieties;

(5) A wider application of fertilizer, including mineral fertilizer, especially on podsollic soils of forest and mountain districts;

(6) The maintenance and raise of the buckwheat yield, and large-scale experiments on advancing winter-resistant varieties of winter wheat in districts of sufficient snow cover or with snow retention.

Natural conditions in the Bashkir Republic can be divided with the greater or smaller influence of the Ural mountains, which traverse it, into mountain-forest, forest-and-steppe and steppe districts.

X(1) The forest foothill district of the eastern parts of the former Ufa and Sterlitamak cantons and part of the Zilair canton, are foothill forest-and-steppe with deciduous forests (oak-linden and oak-birch on the western slopes of the Ural mountains, birch and partly pine on the eastern). Chernozem soils of this district, although leached and degraded and partly gravelly, are in general sufficiently favorable. Because of the influence of the mountains, the climate sufficiently humid (150-175 millimeters for May-July, and an average relative humidity at 1 p. m. in June of 55 percent), with a frostless period of 125-140 days, also contributes to reliable harvests not only of oats but also of spring wheat.

The agriculture of the district, due to natural conditions and the proximity of plants (in the neighboring southern Urals: Beloretsk and others) ought to be given over not only to spring wheat-oats but also to potato-hemp-grass cultivation (possibilities of developing dairy farming).

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Spring wheat here gives harvests which are generally sufficiently reliable and higher than in the other parts of the spring wheat region, and ought to be of leading importance because of the utilization of wastelands and a certain reduction in rye sowing, which is large here.

It is desirable to expand, as supplementary crops, hemp, potatoes (and vegetables), and also buckwheat, which, thanks to the sufficient amount of precipitation may yield good harvests here.

Considering the expediency of developing dairy farming, in addition to natural fodder available, grass sowing ought to be expanded here; and, in addition, together with one-crop Ufa clover (with timothy), ^{alfalfa} lucerne and brome grass also ought to be utilized, and for green fodder rye and a vetch-oats mixture; for silage -- sunflower, vetch-oats mixture, and corn; root-tuberous plants -- beets and potatoes.

X(2) To the northwest of the above-mentioned district is a district consisting of part (a) -- on the right bank of the River Belaya, mixed forests on forest soils -- and part (b) -- on the left bank, forest-and-steppe on forest soils and leached chernozems. The district occupies the former Bira Canton, the northwest of the former Belebey Canton and the north of the former Ufa Canton, and belongs to the more northern type of agriculture with emphasis on rye, oats, clover, potatoes, and hemp.

The sufficiently humid climate (160-185 millimeters of precipitation for May-July), the absence of droughts, the summer heat averaging for July 18-19 degrees Centigrade and the sufficiently long frostless period (120-130 days) favor flax cultivation, clover sowing (especially in part "a") and also a development of hemp and

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potato cultivation. Despite the low winter temperatures (the average January temperature, minus 15 to minus 16 degrees Centigrade), the abundance of snow (as high as 70 centimeters^{of} snow covering at the end of winter), protects rye from freezing damage and even allows us to promote winter wheat.

Varieties: rye -- Vyatka, oats -- Moskovskiy A-315 [sic -- A-0315 also given -- same ?] (Pobeda admissible).

Spring wheat gives reliable harvests, and may be expanded into a supplementary crop; varieties: ^CSezium 0111, Lyutetsens 062 admissible, and for more southern parts the late-ripening Gordeiforme 010 and Mil'turum 0321.

At present, one of the main centers of buckwheat is here. This could remain, because buckwheat cultivation is being reduced in other districts specializing in more valuable crops -- in the Central Black Earth Region and in the Ukraine.

Of secondary crops, millet and spelt ought to be eliminated, while peas, vetch, and also the opium poppy should be greatly expanded.

Fodder crops are the same as in the preceding district, and ought to be in every way expanded.

X(3b) Represents northern forest-and-steppe of the western Siberian type (with strips of oaks on leached and degraded chernozems) of the Mesyagutov Canton, located (together with a part of the Kungur Okrug of the Ural Oblast) in a forest zone.

This district, its good soils lying as a wedge in the zone of sufficient moisture (above 175 millimeters for May-July, with a relative humidity at 1 p.m. in June of 51-53 percent^{and} with a frostless period of 125 days, appears as an oasis of the spring wheat zone entering into the south.

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This is one of the best districts in the Union for yield and stability of yield of spring wheat. Spring wheat ought to be the leading crop (varieties -- ^CBezium 0111, and, admissible, Lyutestsens 062), replacing oats (varieties -- Moskovskiy A-315 [sic?] and, admissible Pobeda), which is at present of equal importance.

Rye remains a supplementary crop (Vyatka variety). Considering the height of the snow cover in this district, it would be desirable to proceed with tests on a large scale of winter wheat of the Moskovskiy type.

The especially favorable conditions for fodder crops and the necessity of expanding dairy farming (with the proximity of industrial plants) demand development in these lines in every way possible. It is especially necessary to strengthen clover sowing (also, for seed -- Perm' clover), and sowings of a vetch-oats mixture and of rye for green fodder; also, sunflower and sweet clover for silage; root-tuberous plants -- potatoes, turnips (Brassica napus rapifera and Brassica campestris rapifera), beets.

X(3a) Semi-arid southern forest-and-steppe and steppe on rich chernozem soils, the western part of the former Sterlitamak Canton, the southeastern former Belebey Canton, and the southwestern part of the former Ufa Canton.

The climate is more arid (only 125-150 millimeters of precipitation for May-July), but because of the hotter summer (averaging 19.5 - 20 degrees Centigrade for July) and the large frostless period 140-145 days), this district falls in the spring wheat region, with winter rye and oats still very important, and possibilities of expanding cultivation of sunflowers.

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